2. PROJECT DESCRIPTION AND ALTERNATIVES

2.1 Introduction

This chapter begins with a summary description of the Haile Gold Mine Project proposed by the Applicant. The chapter also discusses connected actions (infrastructure actions needed to support the Project that are not part of Haile's DA permit application) and the identification and selection process for alternatives to the Applicant's Proposed Project. The alternatives analysis was in part guided by comments received from the public, agencies, and tribes during scoping; and these comments are summarized in the chapter. The chapter also describes the No Action Alternative.

2.1.1 Project Description

A detailed description of the Applicant's Proposed Project is necessary to perform a comprehensive environmental analysis. The project description should define the geographic Project area, the layout of facilities in the proposed Project area, and the facilities and operations to be conducted in the Project area. It should discuss the construction sequence for the Project; the construction schedule; labor force requirements; and any regulated air, water, or waste emissions that would occur routinely or that could occur as a result of a disruption in routine project operations. Upon completion of mining operations, a mine closure and reclamation plan also should be included. As part of mine permitting, financial assurance would be required pursuant to the South Carolina State Mining Act (R-89-200).

The Applicant's revised DA permit application (dated August 15, 2012) and supporting documents form the basis for the description of the proposed Project. This chapter contains a summary description of the Applicant's Proposed Project (see Section 2.2); the detailed Project description is in Appendix A.

2.1.2 Identification and Evaluation of Project Alternatives

To comply with NEPA regulations, the EIS must identify and evaluate a range of reasonable alternatives to the proposed Project. In addition to meeting the requirements of NEPA, the evaluation of alternatives provides the basis for the USACE to make specific findings under Section 404(b)(1) of the CWA. The alternatives evaluation must comply with the following regulations and guidelines.

- **The National Environmental Policy Act –** To comply with NEPA, regulations developed by the CEQ and the USACE require a detailed analysis of reasonable alternatives to the proposed project and their associated potential environmental consequences so that their comparative merits may be considered by agency decision makers (40 CFR 1502.14[b]). The alternatives evaluation must include the applicant's proposed project, the no action alternative, and a range of other potential reasonable alternatives to the proposed project. The range of potential reasonable alternatives that should be considered includes alternative sites, alternative project configurations, alternative technologies, and alternative project sizes.
- **The Section 404(b)(1) Guidelines –** In addition to meeting the requirements of NEPA, the USACE's regulations implementing the 404(b)(1) guidelines dictate that the USACE may not issue a DA permit without making a finding that no practicable alternative to the proposed project exists that would have less adverse impact on the aquatic environment (Waters of the U.S.), so long as the alternative does not have other significant adverse environmental consequences. This regulatory finding must be supported by an alternatives analysis.

  AUSACE-prepared EIS involving a DA permit application should be thorough enough to determine compliance with NEPA and the 404(b)(1) guidelines. These regulations use different criteria for the types of alternatives that should be considered. NEPA considers “reasonable” alternatives, and the 404(b)(1) guidelines consider “practicable” alternatives. *Reasonable* alternatives include those that are practical or feasible from a technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant (46 Federal Register [FR] 18026). An alternative is *practicable* if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant which could reasonably be obtained, utilized, expanded, or managed in order to fulfill the basic purpose of the proposed activity may be considered (40 CFR 230.10). As noted in Chapter 1, the regulations further require that the USACE alternatives analysis identifies the least environmentally damaging practicable alternative (LEDPA).

After a full range of alternatives has been identified and evaluated, the No Action Alternative, the Applicant’s Proposed Project, and the Modified Project Alternatives (i.e., reasonable alternative) will be moved forward and evaluated in detail in the EIS (40 CFR 1502.14[a]).

The USACE has completed an identification and evaluation of alternatives for the proposed Haile Gold Mine Project and has identified the alternatives to be evaluated in detail in the EIS. The alternatives analysis conducted by the USACE and described in this report complies with NEPA and provides the basis for the USACE to make the required findings under the 404(b)(1) guidelines.

- **Section 401 Water Quality Certification** – The SCDHEC reviews applications for 401 Water Quality Certification. This certification is required for projects requesting a federal permit for activities that, during construction or operations, may result in any discharge to Waters of the U.S. The SCDHEC must address and consider whether there are feasible alternatives to an activity proposed in an application. In accordance with R. 61-101, *Water Quality Certification*, an application for 401 Water Quality Certification will be denied if a feasible alternative to the activity would reduce adverse consequences on water quality and classified uses. The SCDHEC will use the alternatives analysis described in this EIS to address and consider whether there are feasible alternatives to the proposed Project.

2.2 Description of Applicant’s Proposed Project

2.2.1 Project Site

The proposed Haile Gold Mine Project is located in north-central South Carolina, 3 miles northeast of the town of Kershaw in southern Lancaster County (Figure 1-1). The proposed Project boundary includes a total of 4,552 acres, of which approximately 2,612 acres[1] would be used for Project features (Figure 2-1). The Project area includes the land inside of the Project boundary, with the exception of two land parcels that are not owned by Haile, as shown in Figure 2-1. Although the site was previously mined for gold and other materials, there is no active mining at present. The site is currently undergoing post-closure monitoring for the former mine workings and has no other ongoing commercial, industrial, or urban activities.

[1] The area estimated for Project features does not include the area of a disturbance buffer around the design footprint of each mine component. (See Table A-1 in Appendix A.)

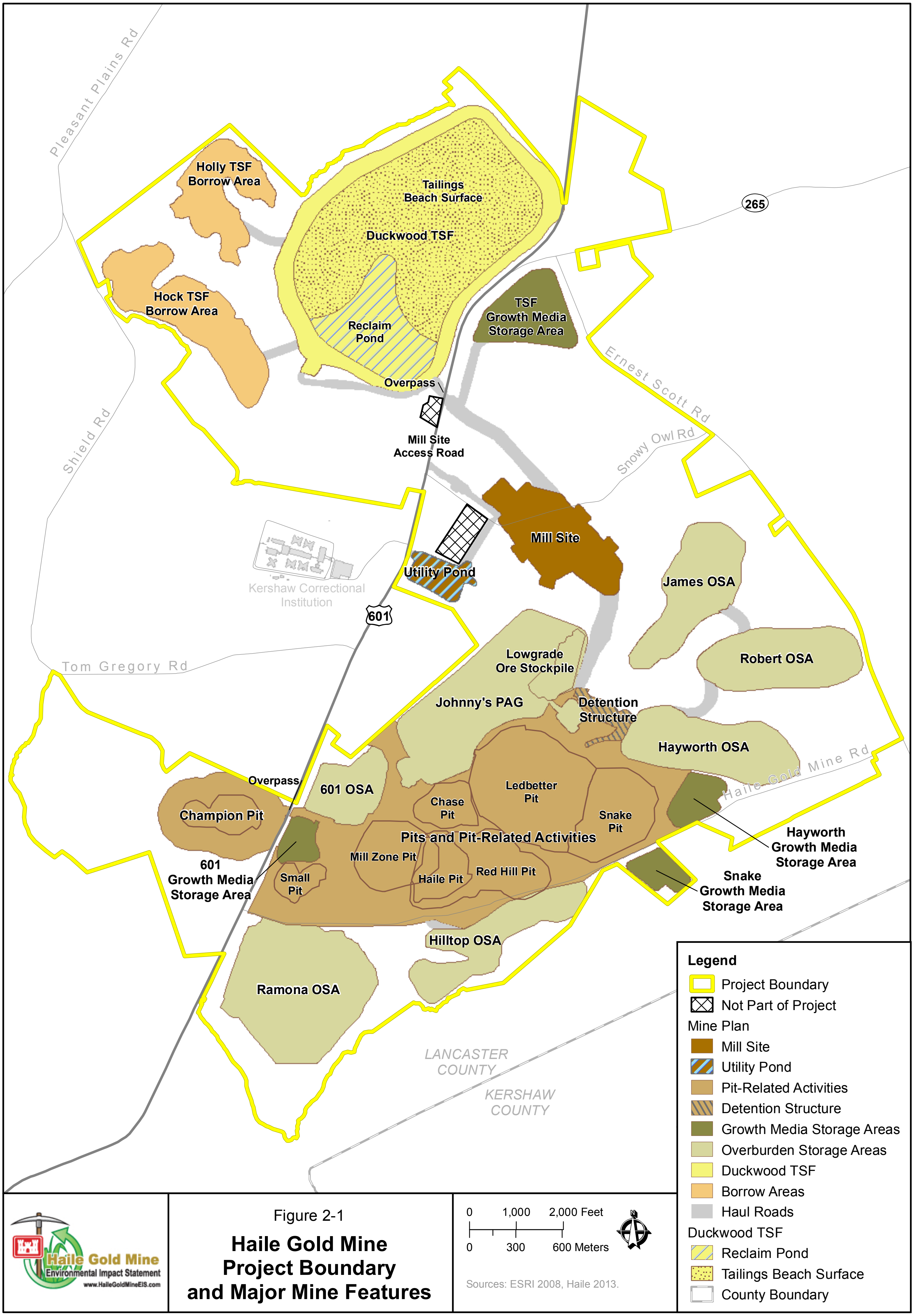


Figure 2-1

Haile Gold Mine Project Boundary and Major Mine Features

2.2.2 Overview of Mine Development

The proposed Project consists of opening new mine pits and processing available reserves to extract gold and other associated precious metals from ore. Project facilities would include mine pits where overburden and ore would be extracted, overburden storage areas, growth media storage areas, a processing Mill to extract and refine gold with associated maintenance and administrative facilities, a tailings storage facility, water storage ponds, sediment detention ponds, a water treatment plant, roads, laydown areas, borrow areas for construction materials, and temporary construction areas (Figure 2-1). The Glossary contains definitions of the scientific and mining terms used in this EIS.

Each major activity of the mining process is described briefly in the subsections below. The active mining and processing portion of the proposed Project is estimated to last approximately 15 years. This includes 1 year of pre-production and construction, 12 years of excavation, and 2 years of low grade ore processing after active mining is completed. Table 2-1 summarizes the sequence of mine construction and operation. Further information is available on the Haile Gold Mine EIS website at the Mine Interactive Experience (MInE): http://www.hailegoldmineeis.com/interactive-map/index.html.

The proposed Project spans US 601, and three currently open Lancaster County roads (Snowy Owl Road, Gene Lewellen Road, and Bumblebee Road [also known as Gary Road]) occur within the Project boundary. To facilitate safe vehicle access throughout the Project boundary, avoid truck traffic at intersections, and reduce traffic on US 601, several actions are proposed. Haile would close all or portions of the three open Lancaster County roads and parts of one road maintained by the South Carolina Department of Transportation (SCDOT) (Haile Gold Mine Road), and some existing traffic would be diverted from their current travel routes. Two overpasses would be constructed (Figure 1-5) to allow vehicles to travel throughout the Project boundary without using US 601. The intersection of Snowy Owl Road and US 601, at the entrance to the Mill, would be improved to include a left-turn lane for southbound US 601 traffic onto Snowy Owl Road and a right-deceleration and turn lane in the northbound direction of US 601 onto Snowy Owl Road.

Mine Features

Mine pit. An open pit where overburden containing ore is mined.

Overburden storage area (OSA). An area designated for storage of the overburden removed from the mine pit.

Growth media storage area. The surface portion of the soil and overburden that may be re-used as soil. This material is stored in large aboveground piles for later use.

Mill. The facility where ore is crushed and concentrated, and from which gold is chemically extracted (separated) from the ore to be smelted into doré bars.

Tailings storage facility (TSF). A facility for long-term storage of tailings. The TSF includes both solid and liquid materials.

Water storage pond. An impoundment for liquid wastes that would be biochemically treated.

Sediment detention pond. A water impoundment made by constructing a dam or an embankment, or by excavating a pit.

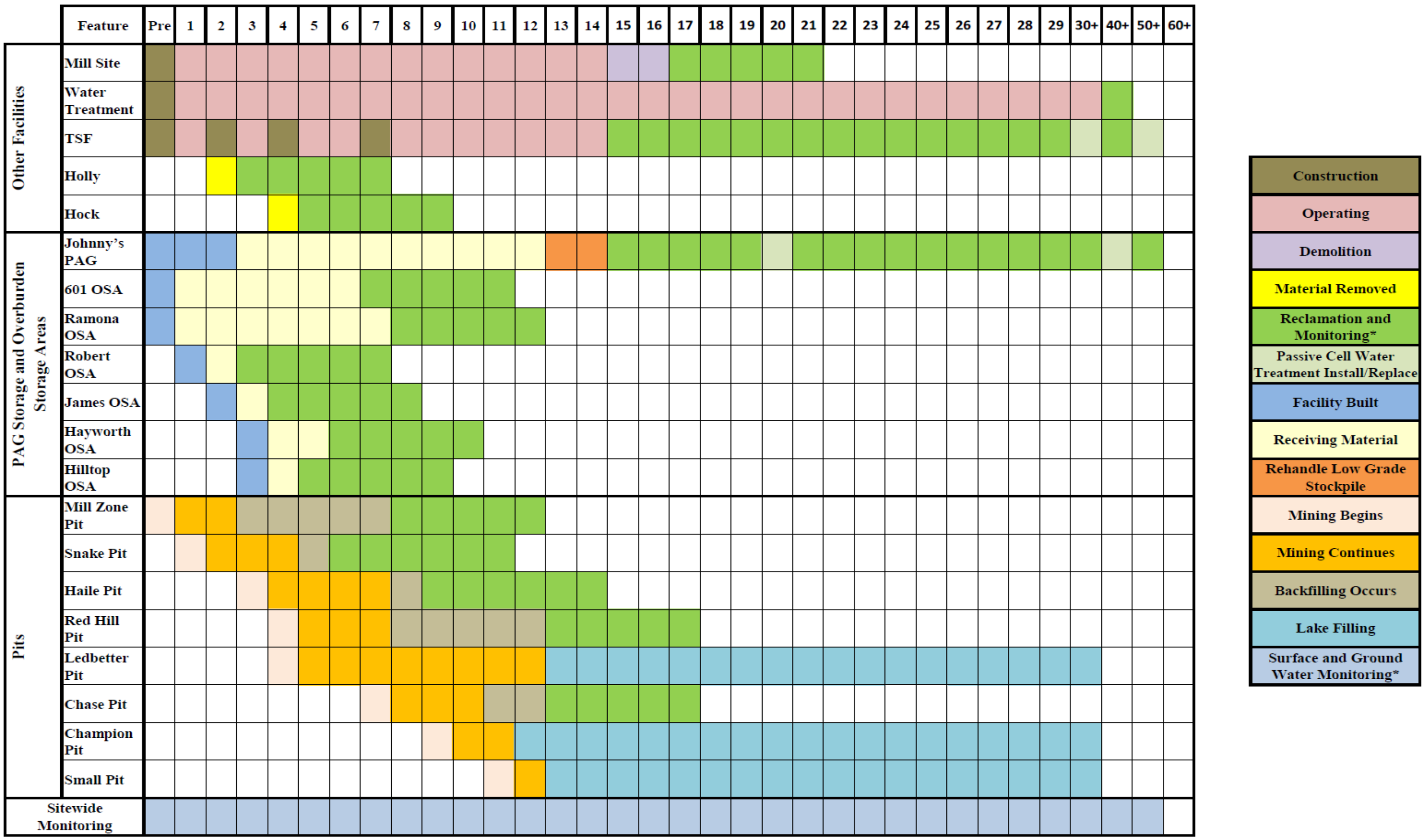
Water treatment plant. A self-contained facility that cleans waste water from mining facilities so that it can be re-used at the site or released to the environment.

Laydown area. An area used to stage or store equipment and materials during construction or demolition.

Borrow area. An area excavated for construction materials.

Temporary construction area. An area used during construction which would be reclaimed post-use.

Table 2-1 Mining Schedule – Timing of Mine Features by Year



Notes:

Pre = Pre-Production

Johnny's PAG would receive material during construction in the Pre-Production phase but would not be fully constructed until Mine Year 3.
The period of monitoring would be in accordance with South Carolina Department of Health and Environmental Control regulations.

Source: Haile 2012a (table revised in 2013).

2.2.3 Site Preparation

Prior to commencing mining operations, some land would be cleared of vegetation for construction and mine operations, access roads would be constructed, and excavation of the first mine pits would begin. During this process, topsoil and near-surface material (also referred to as *growth media*) would be removed and stored in special growth media storage areas for later use during the reclamation process. The growth media storage areas are shown in Figure 2-1 and are named "TSF," "Hayworth," "Snake," and "601."

2.2.4 Excavation and Material Storage

The layer of soil and rock that overlies the ore is called *overburden* (separate from the growth media). Overburden would be removed by drilling, blasting, and mechanical excavation. The overburden would be transported to specially designed storage piles known as *overburden storage areas* (OSAs) (Figure 2-1). The overburden would be stored in different OSAs based on its acid generation potential, as further discussed below. These OSAs would be located close to the mine pits to minimize transport.

Some overburden material would be used for construction of other mine facilities and to backfill pits during mining operation. Other overburden would remain in the OSAs permanently and would be covered with topsoil and revegetated concurrently during mine operation or during reclamation to become part of the post-mining landscape. Six OSAs are proposed for non-acid-generating overburden—James, Robert, Hayworth, Hilltop, Ramona, and 601—and one specially designed storage facility for potentially acid-generating (PAG) overburden—Johnny's PAG (Figure 2-1).

> ***Excavated Materials***
>
> Overburden. Layers of soil and rock covering an ore deposit. Overburden is removed prior to mining the gold-bearing ore and may be replaced after the ore has been removed for processing.
>
> Growth media. The surface portion of the soil and overburden that may be re-used as soil.
>
> PAG Classes. Overburden with higher percentages of pyritic sulfur has greater potential for acid generation (PAG).
>
> - Green Class: less than 0.2 percent pyritic sulfur.
> - Yellow Class: between 0.2 and 1 percent pyritic sulfur.
> - Red Class: greater than 1 percent pyritic sulfur.
>
> Saprolite. Soft, thoroughly decomposed rock rich in clay.
>
> Tailings. The material by-product of the gold extraction process. Tailings occur in the form of slurry composed of powdery material and rejected liquids used in the gold extraction process.
>
> *The Glossary contains definitions of all mining terms used in this EIS.*

Overburden would be stored in the appropriate OSA or used for construction of Project facilities based on its potential to generate acid from sulfides (further discussion on acid generation is provided in Section 4.1). An overburden management plan has been developed based on analysis of drilling cores obtained during exploration of the Project area and is included in the Monitoring and Management Plan (MMP) (Appendix G). The bottom 50 feet of the saprolite (approaching bedrock) and blasthole samples within bedrock layers would be periodically tested prior to excavation in order to classify overburden according to its potential to generate acid (as indicated by the amount of pyritic sulfur present). Overburden with greater than 1 percent pyritic sulfur (designated as Red Class overburden) has a high potential to generate acid and would be stored only in a special storage area called Johnny's PAG (Figure 2-1). A high-density polyethylene (HDPE) liner and a drainage system for collection and treatment of runoff would be installed at this facility. It also would be equipped with an underdrain system for collection of seepage and requires a State-approved plan for closure when mining was completed. Some low grade ore also would be temporarily stored in Johnny's PAG because of its higher potential to generate acid.

Overburden with pyritic sulfur levels between 0.2 and 1 percent (designated as Yellow Class overburden) would be used as pit backfill or stored at Johnny's PAG, and overburden with less than 0.2 percent pyritic sulfur (designated as Green Class overburden) would be stored in other OSAs on the site. Of the total amount of overburden to be produced during the planned life of the mining operation, by far the largest portion would be Green Class. Testing of drilling cores during exploration found that the overburden nearest the ground surface generally has the least potential for acid generation and metals leaching, and is suitable for construction fill or embankments.

2.2.5 Pit Depressurization

Because the mine pits must be dry during mining, the groundwater table would be lowered to minimize groundwater influx into the pits Wells would be installed around the pit locations and pumped to lower the groundwater table. This process, called *depressurization*, can take many months to years; depressurization would be started well in advance of pit excavation. The water produced from pit depressurization would be used in the milling processes or discharged to Haile Gold Mine Creek, if necessary. Rain falling into the pits and groundwater seepage into the pits from the pit walls would be removed with sump pumps and used in the Mill, or treated and discharged (see Section 2.2.4.5 for more details on water management). Note: the USACE is fully aware of concerns regarding depressurization. Extensive analysis and modeling of groundwater were conducted. A detailed discussion is provided in Section 4.3.

2.2.6 Ore Extraction

After the overburden has been removed and the pit dewatered, the gold-bearing ore would then be mined. Ore would be extracted by blasting and use of heavy earth-moving equipment. A total of eight open pits would be mined within the area designated in Figure 2-1 as "Pit-Related Activities." The depth of the mine pits would range from 110 to 840 feet. Four of the mine pits would be fully backfilled with overburden after the ore has been extracted: Mill Zone, Red Hill, Chase, and Haile. Other pits would not be backfilled or would be partially backfilled; these pits eventually would fill with groundwater (Table 2-1) and runoff to become pit lakes: Champion, Small, and Ledbetter. Three pit lakes would remain after mining (Ledbetter Pit and the partially backfilled Snake Pit would combine to form a single pit lake, and Champion and Small Pits would form individual pit lakes) (see Section 2.6.1.9 for additional details). The pit lake water quality would be monitored and managed to ensure that water quality meets applicable requirements.

2.2.7 Gold Processing

The gold-bearing ore would be removed from the pits and transported to the Mill Site (also referred to as the *Mill*) (Figure 2-1) in large haul trucks. Approximately 7,000 tons of ore is proposed to be processed each day. The process includes crushing, grinding, concentrating, and recovering the gold, and then smelting it into dore bars (also referred to as *doré bars*). The extraction process would be carried out in aboveground tanks within a secondary containment system. The mine's administrative facilities, including offices, parking areas, and safety facilities, also would be located within the Mill Site (Figure 2-1).

The Mill Site includes processing facilities, chemical storage facilities, spill containment structures, and the contact water treatment plant. Chemicals and reagents, including cyanide, would be stored or used at the Mill Site. The use of cyanide at the Haile Gold Mine and its potential effects are addressed in this

Draft EIS. The Applicant's proposed use, recovery, and management of cyanide in the gold refining process, and tailings storage and disposal is described in Appendix A. More about cyanide, its chemical forms, and its occurrence in the mining and tailing processes is provided in Section 4.1, "Approach to Environmental Analysis". The potential impacts of cyanide including its effects on air quality, water quality and wildlife are addressed in Section 4.16, "Air Quality", Section 4.4, "Surface Water Hydrology and Water Quality", and Section 4.8, "Terrestrial Resources". Haile has committed to manage cyanide use at the Haile Gold Mine in compliance with the International Cyanide Management Code for the Manufacture, Transport, and Use of Cyanide in the Production of Gold (Code) (International Cyanide Management Institute 2014). Companies that adopt the Code must have their mining operations that use cyanide to recover gold audited by an independent third party to determine the status of Code implementation. Other chemicals and reagents are discussed in Sections 3.19 and 4.19, "Hazardous Materials and Waste."

Some of these chemicals and reagents are potentially toxic and dangerous, and must be carefully managed. A Solid and Hazardous Waste Management Plan that includes a waste analysis and designation, container management, record keeping, personnel training, and emergency response would be used to manage these materials. Appendix A provides a discussion of the gold processing facilities.

2.2.8 Tailings Storage

Spent ore from the gold processing plant, called *tailings*, would be mixed with water to make a slurry and piped along the Duckwood Tailings Storage Facility (TSF) haul road to the Duckwood TSF. The TSF is designed for permanent storage of all tailings produced during operation of the Mill. The slurry would be discharged into the Duckwood TSF, where the process water would separate from the coarse, sand-like solids of the tailings. This would form a tailings "beach" and a pond, the Reclaim Pond (Figure 2-1). Tailings from the Mill would be pumped in a double-contained pipeline system (with one pipe placed inside another containment pipe) that minimizes the potential of an accidental spill to the distribution system along the interior crest perimeter of the TSF embankment. Process water would accumulate in the TSF Reclaim Pond, where it would be collected and recycled back to the Mill Site. The reclaim pipeline is also a double-contained system.

The TSF basin would be fully lined with a 60-millimeter HDPE geomembrane underlain by 12 inches of a compacted low-permeability soil liner. Above the geomembrane liner, a network of perforated pipe and 18 inches of a drainage layer material would be built to collect and route underdrainage from the tailings to a central collection point. The basin would be graded to promote gravity flow to the downstream TSF Underdrain Collection Pond. An HDPE geomembrane double-lined pond with a leak collection and recovery system (LCRS) would be constructed downstream of the embankment toe, at the southwest corner of the facility, for collection of underdrainage flows from the basin through a concrete-encased series of outlet pipes. The TSF would cover an area of approximately 524 acres and would be open to the air. Except for water that evaporates, any precipitation that falls on the facility would become part of the closed-loop process water system.

The Duckwood TSF would be constructed near the northern end of the proposed mine site (Figure 2-1). The TSF would be constructed in phases over the first 7 years of the Project and would be expanded as the amount of stored tailings increased. The initial construction would be accomplished using material excavated from the TSF basin. Later stages would use material excavated from the Holly and Hock TSF borrow areas (Figure 2-1). Further information on the TSF design, including figures, is in Appendix A.

2.2.9 Water Management

The water management plan for the mine consists of three systems. The first is the closed-loop Mill process water cycle. This would include the Mill Site and the Duckwood TSF that would be connected by the tailings slurry pipeline and a return flow pipe. Water in this loop would be continuously recycled, and water to make up for evaporative and other losses would primarily come from pit depressurization.

The second system, the contact water management system, would collect in lined collection ponds near the Mill. All rainfall, runoff, or seepage that comes into contact with Johnny's PAG, the low grade ore stockpile, or mine pits, would be considered contact water. Contact water may be used to supplement Mill processes before or after treatment. If not used at the Mill, effluent from the contact water treatment plant would be discharged to Haile Gold Mine Creek in compliance with a state permit issued by the SCDHEC under the NPDES permit program.

The third water management component is the non-contact water management system. All rainfall and runoff from areas of the mine not in contact with PAG materials (e.g., Green Class OSAs, borrow areas, and roads) would be managed as stormwater, in compliance with a state permit issued under the NPDES permit program.

2.2.10 Monitoring and Facility Management

Construction, operation, and reclamation of the proposed Project would be subject to requirements of federal and state permits and certifications. Among them are a DA permit issued by the USACE under Section 404 of the CWA and a Mine Operating permit, NPDES permits under Section 402 of the CWA, and Water Quality Certification pursuant to Section 401 of the CWA, all issued by the SCDHEC. Appendix F contains a complete listing of required permits for the Project and their status. Several of the permits would include long-term monitoring requirements as part of permit compliance, and specify remedial actions or management response should monitoring detect that the Project is not operating within the conditions or parameters specified in the authorizations.

In addition to the ongoing monitoring programs, most mine facilities and resources have plans that describe how facilities and resources will be operated, monitored, and maintained. Current copies of these plans can be viewed on the USACE Haile Gold Mine EIS website (http://www.hailegoldmineeis.com).

These plans include:

- Tailing Storage Facility Operations, Inspection, and Maintenance Manual
- Tailing Storage Facility Emergency Action Plan
- Overburden Management Plan
- Reclamation Plan

The Applicant has incorporated many of the measures included in these plans into an MMP (Appendix G). These preliminary plans would be finalized after permits are received, based on relevant permit conditions. The Applicant would develop additional plans to comply with other operational standards and regulations. These plans include:

- Operations Plans for each major facility
- Spill Prevention, Control, and Countermeasures (SPCC) Plan
- Stormwater Pollution Prevention Plan (SWPPP)

- Overburden Material Testing Program
- Operational Water Quality Monitoring and Management Plan
- Solid and Hazardous Waste Management Plan
- Post-Closure Water Quality Monitoring and Management Plan

2.2.11 Site Reclamation and Closure

Under Section 48-20-20 of the South Carolina Mining Act (SCMA), no mining may be conducted in the state unless plans for the mining include reasonable provisions for protection of the surrounding environment and for reclamation of the area of land affected by mining. Land disturbed by mining, ore processing operations, and associated activities at the proposed Haile Gold Mine would be reclaimed in compliance with regulations and standards outlined in an individual Mine Operating permit issued by the SCDHEC Mining and Reclamation Program, Division of Mining and Solid Waste Management. These regulations and standards are designed to provide for the long-term protection of land and water resources, to minimize the adverse impacts of mining, and to support potential post-mining land use.

The Applicant has submitted a Reclamation Plan that describes measures that would be used at the site (Appendix H).

After reclamation and closure, the site may be suitable for other future land uses. The Duckwood TSF and Johnny's PAG would need to be maintained in an undisturbed condition for perpetuity to protect and maintain the integrity of the closure systems. Other areas of the remaining property may be suitable for uses such as recreation or silviculture. Designated or targeted future uses for the mine site are identified in the Applicant's Reclamation Plan.

What is Reclamation?

According to the South Carolina Mining Act, *reclamation* means the reasonable rehabilitation of the affected land for useful purposes, and protection of the natural resources of the surrounding area.

Although both the need for and the practicability of reclamation control the type and degree of reclamation in a specific instance, the basic objective is to establish on a continuing basis the vegetative cover, soil stability, water conditions, and safety conditions appropriate to the area. Closure activities are a part of reclamation.

What is Mine Closure?

Closure means the act of rendering a mine facility or portion of a mine facility to an inoperative state that prevents the gradual or sudden release of contaminants that are harmful to the environment.

2.2.12 Mining Schedule of Operations

The active mining and processing portion of the Project is estimated to last approximately 15 years. This includes 1 year of pre-production and construction, 12 years of excavation, and 2 additional years of low grade ore processing (Table 2-1). The mine plan includes concurrent reclamation, whereby reclamation in some areas would begin as soon as mining activity in the area was completed but before completion of all ore processing. Reclamation and closure would extend beyond the 15-year period, and environmental monitoring would go on for many years thereafter (Table 2-1).

2.2.12.1 Project Workforce

Pre-production construction would require approximately 704 employees, including contractors; this amount would be reduced to 500 employees during peak production at the mid-point of operation and decreased to 153 employees by the end of the 15-year mine plan. Some employment would continue through the post-closure period.

2.3 Connected Actions

For the purposes of this NEPA review, *connected actions* are defined as actions that are closely related and therefore should be discussed in the same EIS. As defined in 40 CFR 1508.25(a), actions are connected if they:

> *(i) Automatically trigger other actions which may require environmental impact statements; (ii) cannot or will not proceed unless other actions are taken previously or simultaneously; and (iii) are interdependent parts of a larger action and depend on the larger action for their justification.*

2.3.1 Description of the Connected Actions

Haile has identified supporting infrastructure actions associated with, but separate from, the proposed Project that are not part of the Applicant's DA permit application. These actions include electric transmission and other supporting infrastructure facilities, including natural gas transmission, potable water, fire protection water, and sewage facilities. Construction and operation of these facilities would occur because of, but independent from, the proposed Project. The currently proposed route of the transmission line and supporting infrastructure facilities shown in Figure 2-2 is not located within navigable Waters of the U.S. and therefore would not require a DA permit.

Information about these proposed infrastructure projects is presented below. In most cases, only limited information was available on the proposed design, construction, and operation of the actions. Although the permit applications for these actions would be reviewed and acted on by other agencies, the potential impacts of these infrastructure projects are discussed in Section 4.20 of the EIS.

2.3.1.1 Electric Transmission

The Haile Gold Mine spans the boundary between the Duke Energy franchised electric service territory and the service area for the Lynches River Rural Electric Cooperative (LRREC). An agreement was reached between Duke Energy, LRREC, and Haile under which Haile would enter into an agreement with Duke Energy to supply the power, and LRREC—along with their engineering and construction partner, Central Electric Power Cooperative (Central Electric)—would construct a new 69 kilovolt (kV) overhead power line and a 69 kV/24.9 kV substation to serve the proposed Project. The new connecting 69 kV line would be approximately 4.5 miles long and would be routed within an existing transmission line right-of-way and adjacent to or within existing road rights-of-way. This route would generally be the shortest route between the point of interconnection and the substation (see Figure 2-2).

Central Electric has an existing 69 kV line that runs in an east-west direction north of the proposed Haile Gold Mine site. The interconnection point for the new connecting 69 kV transmission line is just north of State Highway 903, near the intersection of Duckwood Road. The proposed route would run south along Duckwood Road to US Highway 601 (US 601) and then parallel US 601 to the south until reaching the Haile Gold Mine TSF haul road. From there, the route would parallel the haul road easterly to its terminus at the Lynches River substation, which would be located on the Haile Gold Mine site. The transmission line would be constructed within a 70-foot-wide right-of-way and would generally run within or alongside the existing Duckwood Road and US 601 utility right-of-way. Haile would deed to LRREC approximately 0.5 acre of land adjacent to the Mill Site for construction of the Lynches River substation.

Figure 2-2

Proposed Transmission Line Route

Haile discussed with Central Electric alternative transmission line alignments between Haile's onsite substation and the interconnection point, and reviewed four alternative routes with Central Electric. Central Electric determined that the route shown in Figure 2-2 represented the least amount of impact and the least cost route, primarily because it parallels existing infrastructure (Haile 2012a).

Central Electric designs all of its overhead transmission lines to 115 kV configuration (e.g., tower type and height, and conductor separation), even if the lines will operate at a lower voltage—in this instance, at 69 kV. This type of transmission tower is typically a single-pole steel or wood structure with three conductors mounted on insulators. The peak electrical load for the Haile Gold Mine would be approximately 14 megawatts (MW), while the typical operating load would be from 11 to 12 MW. Power would be distributed throughout the site via underground duct banks as well as by a series of 24.9 kV overhead lines. Figure 2-2 shows the 24.9 kV overhead power lines around the Mill Site and Central Electric's incoming 69 kV overhead power line.

The transmission line would be constructed as a separate project by Central Electric under the regulatory supervision of the South Carolina Public Service Commission. Central Electric would be responsible for obtaining the proper permits and approvals to build the transmission line. Although Central Electric has not identified what permits would be required for construction and operation of the transmission line, Central Electric would follow procedures for siting and environmental review of transmission projects. Design and construction of the transmission line would comply with 7 CFR Part 1794 and guidelines established in the *Design Guide for Rural Substations* (RUS 2001) and the *Design Manual for High Voltage Transmission Lines* (RUS 2009).

2.3.1.2 Supporting Infrastructure Facilities

The proposed Project would require installation a natural gas pipeline, potable water line, fire protection water line, and a sewage line and associated tie-ins to connect the proposed mine facilities to existing utility infrastructure in the region. The needed utility infrastructure would include installation of a connecting natural gas pipeline, a potable water line, a fire protection water line, a sewage line, and associated tie-ins for these facilities. Natural gas would be brought to the Project via a buried pipeline connecting to the Lancaster County Natural Gas Authority near US 601. Natural gas would be used for Project operations. Haile Gold Mine currently obtains potable water from the Lancaster County Water and Sewer District. The proposed Project would be connected to the Town of Kershaw municipal water system that has a water main along US 601 adjacent to the Haile property. Fire protection water is not presently supplied to the Haile Gold Mine site. The current plan is to use Ledbetter Reservoir for water, should fire trucks be called to the site. For the new mine facility, the Town of Kershaw would supply fire protection water from an existing 250,000-gallon storage tank near the Kershaw Correctional Institution via a pipeline installed by Haile. Haile Gold Mine currently uses a septic system, tank, and leach field to dispose of its sewage. The new mine facility would be connected to the Town of Kershaw municipal wastewater treatment facility which has the available capacity to serve the proposed Project.

Figure 2-3 shows the location of the proposed natural gas pipeline, potable water line, fire protection water line, sewage line, and associated tie-ins for these supporting facilities for the Project.

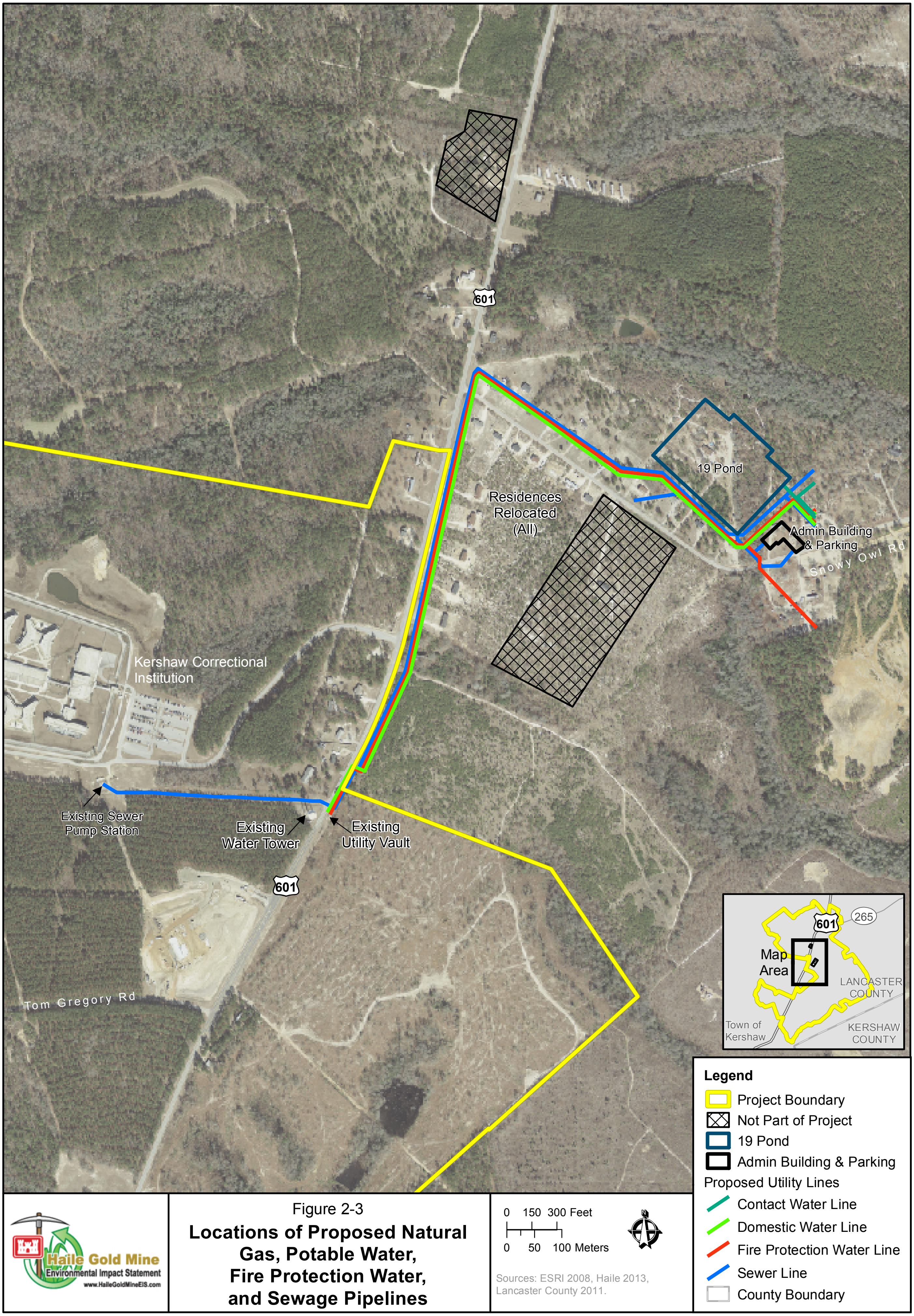


Figure 2-3

Locations of Proposed Natural Gas, Potable Water, Fire Protection Water, and Sewage Pipelines

Sources: ESRI 2008, Haile 2013, Lancaster County 2011.

2.4 Applicant's Alternatives

The Applicant submitted its alternatives analysis in a series of documents developed during 2011 and 2012. The first was an alternatives analysis included in the *Environmental Assessment for Haile Gold Mine Project* (Genesis Consulting Group 2011). In response to a request by the USACE in April 2011, the Applicant submitted the *Haile Gold Mine Project Supplemental Alternatives Analysis* (ERC 2011), which included additional and revised alternatives analyses, and development of three additional alternatives (alternative site configurations, other borrow areas, and other mine sites). The supplemental analysis also included additional evaluation of TSF siting alternatives. On August 15, 2012, the Applicant submitted a revised DA permit application and supplemental information (Haile 2012b) that included a revised site layout and mine plan. This represented an important step in the alternatives evaluation process, as the revised mine plan reduced direct impacts on Waters of the U.S. by (1) reconfiguring mine features (i.e., three OSAs [James, Hayworth, and Hilltop], haul roads, the Holly and Hock TSF borrow areas, the growth media storage areas, and the Mill Site and access road); and (2) removing an impoundment on Haile Gold Mine Creek from the mine plan, among other changes.

The following subsections provide a summary of the analysis performed by the Applicant.

2.4.1 Original DA Permit Application

On January 11, 2011, the Applicant submitted a DA permit application to the USACE (Haile 2011) and an *Environmental Assessment for Haile Gold Mine Project* (Genesis Consulting Group 2011) that included a description of the Applicant's proposed Project and alternatives in three categories:

- Alternative Tailings Storage Facility Sites
- Alternative Mine Plans (mine layouts)
- A No Pit Backfill Alternative

2.4.1.1 Alternative Tailings Storage Facility Sites

The Applicant's preferred location and configuration of the TSF was found through a screening process developed and carried out by Haile that incorporated the following criteria:

- Criterion 1 Location and access – Locations must be within a reasonable distance from the pits and provide access to and from the pits and mine property.
- Criterion 2 Land position – Additional sites must be potentially suitable for the Project needs and able to be reasonably obtained.
- Criterion 3 Public disruption avoidance – Locations must consider the general public health and safety interest and potential public disruption.
- Criterion 4 Technological design considerations – Site characteristics must ensure adequate operational conditions and address environmental concerns and public safety.
- Criterion 5 Impacts on waters – Locations must consider the amount of Waters of the U. S. present.

The Applicant determined that the TSF that they selected met their Project needs, minimized impacts on Waters of the U.S., and was their preferred alternative based on consideration of all the selection criteria**.** This TSF selection was incorporated into the proposed Project (Genesis Consulting Group 2011; ERC 2011).

2.4.1.2 Alternative Mine Plans

Development of the Applicant's proposed mine plan included a pit and ore body identification and configuration process. The location of the mine pits was predetermined because of the location of the ore body; therefore, alternative pit locations were not practicable. The pit locations and sizes were developed to obtain the maximum extent of the economical ore body; to generate the minimum amount of overburden and associated land disturbance; and to ensure the safety of workers, the community, and the environment.

Numerous smaller OSAs were compared to fewer larger contiguous OSAs to assess the potential to reduce the overall OSA footprint. As discussed below (see Section 2.5.1.4), it was determined that fewer, larger OSAs would result in less impact. OSA side slopes were established at the steepest overall angle and height determined to be safe, stable, economically feasible, and suitable for performing successful reclamation and revegetation. The configuration of maximum side slope steepness and storage area height minimized the required footprint of the storage area and associated disturbance (Genesis Consulting Group 2011).

Alternative locations of the OSAs also were analyzed. The Applicant determined that the most effective method of reducing impacts would be to site the OSA footprints, to the degree possible, within the previously disturbed and lower quality ecological areas of the original Haile Gold Mine footprint, while remaining close to the pits. The proposed affected area includes a majority of land previously disturbed by mining operations (Genesis Consulting Group 2011).

The Applicant's proposed mine plan includes the process of concurrent backfill/reclamation. Concurrent backfill (one pit being mined while another is being backfilled) minimizes the need for additional overburden storage in undisturbed areas and reduces the overall mine impact/footprint (Genesis Consulting Group 2011).

2.4.1.3 No Pit Backfill Alternative

The Applicant analyzed an alternative that would not include backfilling of the pits with overburden after mining. Backfilling renders the pits nonviable for additional future mining should economic conditions become more favorable (either a lower unit cost of production or a higher gold price). Less productive ore (ore with lower gold content) could be mined under more favorable economics. Under this alternative, the option of mining additional ore would be preserved, but approximately 67 million tons of overburden that would have been used for pit backfill would need to be accommodated in other OSAs on the mine site (Genesis Consulting Group 2011; ERC 2011).

2.4.2 Applicant's Supplemental Alternatives Analysis

On May 16, 2011, the Applicant provided a Technical Memorandum Regarding the Haile Gold Mine Supplemental Alternatives Analysis (ERC 2011) in response to a request for information by the USACE. This response provided greater detail on the alternatives presented in the original DA permit application and supporting documents. The memorandum also addressed alternative site configurations, other mine site locations in the region, and elimination of the Holly and Hock TSF borrow areas—as described below.

2.4.2.1 Alternative Site Configurations

Two alternative site configurations that considered numerous smaller OSAs were evaluated in the technical memorandum. The Applicant determined that these alternative configurations were not practical alternatives for the following reasons (ERC 2011):

- Increased operating costs;
- Additional haul road requirements would use space that could otherwise be used for OSAs;
- Additional haul road intersection requirements would equate to more hazardous conditions for workers;
- Increased fuel consumption and particulate emissions;
- Increased stormwater controls and monitoring;
- Increased operator liability and risk;
- Expansion of areas storing PAG overburden;
- General increase in surface sprawl of mine-related features;
- Increased reclamation requirements from more surface area to reseed; and
- Expansion of the reclamation liability period.

2.4.2.2 Other Mine Site Locations

At the time of its purchase by Romarco, the Haile Gold Mine included defined mineral reserves (Behre Dolbear & Company 2007) and was the only known location of defined gold reserves (as differentiated from mineral resources [see discussion in Section 1.5) in the Carolina Slate Belt. The Applicant determined that no other known properties could be reasonably obtained, utilized, expanded, or managed by the Applicant for purposes of economically recovering gold resources (ERC 2011).

2.4.3 Revised DA Permit Application

On August 15, 2012, the Applicant submitted a revised DA permit application and supplemental information (Haile 2012b) that included a revised site layout and mine plan. The major changes to the proposed Project included:

- Reconfiguration of the Mill Site, Mill access road, and TSF haul road and pipeline;
- Expansion of the Project area from approximately 4,231 acres to approximately 4,552 acres from acquisition of additional land parcels, allowing the relocation of some facilities;
- Separation and reorientation of the Hayworth OSA into two distinct areas – Hayworth OSA and Robert OSA;
- Creation of a single haul road crossing – Robert OSA haul road – designed to cross the existing Gene Lewellen County Road;
- Reconfiguration of James and Hilltop OSAs;
- Addition of the Holly and Hock TSF borrow areas and haul roads;
- Reconfiguration of some growth media storage areas;
- Inclusion of Champion Pit;

- Replacement of the proposed Haile Gold Mine Creek retention structure with a detention and diversion structure;
- A 50-foot vegetated "no-disturbance" buffer area around otherwise non-impacted Waters of the U.S. where operations would be restricted; and
- An additional 50-foot "disturbance area" (for purposes of calculating impacts on Waters of the U.S.) that generally extends 50 feet from the outermost edge of each facility or disturbance area to allow for incidental access, variation, or modifications upon final construction design; to accommodate temporary construction implementation needs; to support prudent engineering practices; and to implement best management practice (BMP) control measures, as needed.

The revised mine plan (Haile 2012b) results in an approximately 25-percent reduction in overall acreage of direct impacts on wetlands (Waters of the U.S.) and an approximately 32-percent reduction in direct impacts on streams (Waters of the U.S.) compared to the site layout and mine plan filed in the Applicant's initial DA permit application.

2.5 USACE's Evaluation of Alternatives

During the EIS scoping process, the USACE received a number of comments that focused specifically on Project alternatives. These comments were addressed in the draft alternatives development and evaluation report (USACE 2013) and were used to identify alternatives to be evaluated.

Identification and assessment of Project alternatives followed a three-step process:

1. Potential Project alternatives identified by Haile, alternatives suggested during scoping, and alternatives identified by the USACE were listed and considered.
2. Alternatives were screened to determine if they were reasonable and practicable. Alternatives found to be unreasonable or not practicable were eliminated from further consideration, with an explanation.
3. Reasonable and practicable alternatives were carried forward for further detailed analysis in the Draft EIS and compared to the proposed Project and the No Action Alternative.

2.5.1.1 Identification of Alternatives

This section describes the process used by the USACE to identify and evaluate potential alternatives to the Haile Gold Mine to be considered further in the Draft EIS, in compliance with the applicable CEQ and USACE regulations. An explanation of "reasonable" and "practicable" alternatives is provided in Section 2.1 and in Question 4 in the Executive Summary.

A rigorous alternatives analysis was undertaken to identify and evaluate a full range of alternatives to the proposed Project. The outcome of this analysis identified three alternatives that are evaluated in further detail in the Draft EIS:

- Applicant's Proposed Project – The revised project configuration proposed by Haile.
- Modified Project Alternative – The revised configuration for the Ramona OSA and use of the Holly and Hock TSF borrow areas for overburden storage.
- No Action Alternative – Denial of the DA permit for fill of streams and wetlands (Waters of the U.S.). The site post-closure monitoring activities currently underway would continue to their conclusion.

As a starting point for identification and evaluation of alternatives, any project site must have mineable gold reserves. Without reserves, the Applicant's stated purpose "*To produce gold for sale from the mineralized gold-bearing zones on the Haile property*" or the overall project purpose, as determined by the USACE, to "*To open and operate a gold mining operation using gold-bearing mineral reserves in the Carolina Slate Belt region*" cannot be achieved.

Furthermore, establishing the presence of adequate gold resources, and ultimately reserves, is a lengthy and expensive process. Locations such as greenfield sites, with no history of mining, have inadequate information regarding the presence, extent and quality of potential gold resources. Therefore, such sites do not meet the Applicant's purpose or overall project purpose, and are neither practicable nor reasonable alternatives to a site with documented gold reserves. Unlike commercial, residential, or industrial projects where site conditions do not require underlying mineral reserves, a mine must be located in an ore-rich environment that can support a significant capital investment. The ore must be located, explored, sampled, and evaluated thoroughly; and a feasibility study must be completed before extensive permitting and mining operations can begin.

Feasibility Study

- Evaluates the financial viability, technical and financial risks of the project.
- Evaluates the ore body and the proposed mining project to determine whether the mineral resource can be mined economically and therefore represents a viable gold reserve.

The Applicant had conducted an alternatives analysis when exploring potential mining locations and provided extensive information, reports, and feasibility studies to support its decision to mine at the proposed Haile Gold Mine location. The Applicant's exploration in the Carolina Slate Belt region has included prospecting, sampling, mapping, drilling, and other activities involved in searching for ore, as summarized in Romarco's *2012 Annual Report* (Romarco 2013). Haile has stated that the proposed Haile Gold Mine represents the culmination of exploration, resource evaluation, feasibility, engineering design, and environmental studies completed by the Applicant over a period of 6 years. According to the Applicant, the Haile property was purchased by Romarco, Inc. in 2007 with a known gold resource of approximately 700,000 ounces at that time, based on prior exploration and mining.

Given the cost of, and uncertainty in, gold exploration, the USACE determined that it would be neither reasonable nor practicable to require a search for alternative mine locations in areas with no known gold reserves. Therefore, geographic areas within the Carolina Slate Belt without known gold reserves do not meet the overall project purpose, and are neither reasonable nor practicable alternative locations.

The next logical step led the USACE to consider other existing or past gold mines in the Carolina Slate Belt region, because it is recognized that gold reserves and gold mining activity has occurred there.[2] As discussed in Section 2.5.2.1, it was determined that none of the existing or historical major mines in the Carolina Slate Belt region could be considered reasonable or practicable alternative mine sites. Therefore, the USACE then narrowed the range of alternatives to those occurring at the Haile Gold Mine site.

The USACE identified potential alternatives at the Haile Gold Mine site in a number of ways. The first was through the EIS public scoping process, when the USACE specifically solicited comments and suggestions about Project alternatives early in the EIS process.

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[2] In addition, the USACE is unaware of any known gold reserves at previously unmined sites in the Carolina Slate Belt.

Alternatives also were identified through a detailed review of the alternatives analysis provided by the Applicant. As described in Section 2.4, the Applicant developed the proposed Project through a mine planning process that included exploratory drilling to determine the location, extent and quality of mineralization; development of an industry-standard technical, logistical, and economic feasibility study by an independent consultant; and development of a mine plan to optimize extraction and processing of reserves. During this planning process, the Applicant evaluated a number of alternatives, with particular attention to the alternatives and locations for the TSF and OSAs. The mine planning and alternatives evaluation process was documented by the Applicant and was independently reviewed in detail during USACE's process of identifying and assessing potential alternatives.

Finally, the USACE independently identified potential alternatives through a systematic evaluation of alternatives to the proposed Project, starting with the Project location and proceeding through each of the major Project elements.

The USACE evaluated a full range of alternatives using the major Project elements shown in Table 2-2 as the structure for the evaluation.

Table 2-2 Alternatives to Major Project Elements Considered by the USACE

Project Element	Alternatives Considered
Mine locations	Mining gold deposits at other locations in the Carolina Slate Belt
Mining methods	Using methods other than open-pit mining to extract gold-bearing ore
Ore processing methods	Using methods other than the proposed milling and carbon-in-leach method
Mill Sites	Locating the Mill Site at an alternative site
Overburden storage areas	Designing alternative locations and configuration for overburden storage
Tailings storage facilities	Locating tailings storage facilities at alternative sites and/or using different configurations for long-term tailings storage
Water management	Providing for alternative water supplies and water management systems
Roads	Routing and configuring access and haul roads at different locations within the mine site
Transmission lines	Routing transmission interconnections to the mine to a different alignment
Mine operating plans	Developing different scheme and schedules for mine development, operation, and reclamation

2.5.2 Alternatives Evaluated

2.5.2.1 Alternative Mine Locations

As previously discussed, mineable gold reserves must be present to meet the overall project purpose. The proposed Project is located in the Carolina Slate Belt, a geologic region defined by the U.S. Geological Survey (USGS) as extending from Virginia to Georgia (USGS 1988). Since the 1800s, the region has been extensively surveyed for suitable ore deposits; and mining has occurred throughout the region until the present time (USGS 2012).

In assessing alternative mine locations, the USACE considered the following:

- Does the site contain proven gold reserves?
- What would be the impacts on Waters of the U.S.?

Romarco is currently conducting gold exploration activities or drilling at three other locations in South Carolina and two locations in North Carolina (Romarco 2011). A number of other companies such as Strongbow Exploration, Inc. continue to actively explore the region for gold mineralization and target gold resources. Although current results indicate that gold mineralization is present in a variety of locations in the Carolina Slate Belt, only one of these locations–the Haile Gold Mine–has been explored and evaluated sufficiently to determine that economically recoverable quantities of gold are present.

The USACE reviewed five other potential mine sites within the Carolina Slate Belt to determine whether any could be considered as reasonable site alternatives to the Haile Gold Mine site. Evaluation of these five alternative mine locations is summarized in Table 2-3.

Barite Hill Mine

The Barite Hill Mine is located approximately 2.5 miles southwest of the town of McCormick in the Lincolnton-McCormick Mining District. This district includes other small mines and prospects for gold, silver, copper, zinc, lead, kyanite, and manganese. The Barite Hill deposit was mined from 1989 to 1994 by Nevada Goldfields, Inc. and produced approximately 59,000 ounces of gold and 109,000 ounces (3.4 million grams) of silver, mainly from oxidized ore in the 20-acre Main Pit and the 3.93-acre Rainsford Pit. The mine used conventional open-pit mining methods and an on/off heap leach process. In June 1999, Nevada Goldfields, Inc. filed for Chapter 7 bankruptcy and abandoned the property. The property came under control of the USEPA Superfund program and is on the National Priority List for cleanup. Reclamation and closure work began in October 2007. There is no current feasibility study for identifying recoverable reserves for the Barite Hill Mine.

Brewer Mine

The Brewer Mine is located 10 miles northeast of the Haile Gold Mine on a small north-south ridgeline that divides Little Fork Creek and the Lynches River. It is reported to be one of the oldest gold mines in the United States, with the first documented gold production occurring in 1828. The mine produced gold intermittently. First it was a placer mine, then a surface-and-underground mine, and finally it was a low grade cyanide-treated heap leach operation. The most recent production occurred from 1987 to 1995 by the Westmont Mining/Costain Ltd. Group. There is no current feasibility study for identifying recoverable reserves for the Brewer Mine.

In 1990, tropical storm Marco passed over South Carolina, resulting in 120 dam failures statewide. As a result of the 1990 tropical storm, an overflow pond at the Brewer Mine location released water containing sodium-cyanide solution, copper, mercury, chromium, cobalt, nickel, and selenium along 49 miles of the Lynches River. After initial closure activities, the site became a Superfund site in 1999 and is now controlled by the USEPA and on the National Priority List for cleanup.

Howie Mine

The Howie Mine is located in Union County, approximately 3 miles northwest of Waxhaw, South Carolina. This location was mined from approximately 1840 until 1942 and recovered approximately 50,000 ounces of gold. Ore was recovered using both underground and open-pit methods in narrow ore-bearing zones no more than 400 feet wide. The site is presently maintained by a historical society as a museum. There is currently no feasibility study for the Howie Mine and no known estimate of gold reserves.

Table 2-3 Evaluation of Alternative Mine Site Locations

Potential Alternative	Proven Gold Reserves	Impacts on Waters of the United States
Haile Gold Mine	Feasibility study completed in 2010 (M3 Engineering & Technology Corporation). Probable gold reserves are estimated at approximately 2 million troy ounces. Approximately 1,682,000 ounces of gold can be recovered.	Direct effects to approximately 120.46 acres of wetlands and open waters and 26,460.54 linear feet of streams. Potential indirect effects to adjacent wetlands and steams.
Barite Hill Mine	No current feasibility study for identifying recoverable reserves.	Unknown. Would depend on mine plan and feasibility analysis. However, similar stream network density and wetland occurrence in the region suggest that direct impacts may be similar to those of Haile Gold Mine or any similar-sized development.
Brewer Mine	No current feasibility study for identifying recoverable reserves.	Unknown. Would depend on mine plan and feasibility analysis. However, similar stream network density and wetland occurrence in the region suggest that direct impacts may be similar to those of Haile Gold Mine or any similar-sized development.
Howie Mine	No current feasibility study for identifying recoverable reserves.	Unknown. Would depend on mine plan and feasibility analysis. However, similar stream network density and wetland occurrence in the region suggest that direct impacts may be similar to those of Haile Gold Mine or any similar-sized development.
Ridgeway Mine	No current feasibility study for identifying recoverable reserves.	Unknown. Would depend on mine plan and feasibility analysis. However, similar stream network density and wetland occurrence in the region suggest that direct impacts may be similar to those of Haile Gold Mine or any similar-sized development.
Bayberry Mine	No current feasibility study for identifying recoverable reserves.	Unknown. Would depend on mine plan and feasibility analysis. However, similar stream network density and wetland occurrence in the region suggest that direct impacts may be similar to those of Haile Gold Mine or any similar-sized development.
Other locations in the Carolina Slate Belt	No current feasibility studies for identifying recoverable reserves.	Unknown. Would depend on mine plan and feasibility analysis.

Ridgeway Mine

The Ridgeway Mine is located near Ridgeway, South Carolina, approximately 25 miles north of Columbia, South Carolina. The Kennecott Ridgeway Mining Company (Kennecott) mined low grade oxide and sulfide ore from siliceous deposits and produced approximately 1.5 million ounces of gold from 1988 to 1999. The mine was composed of two open pits with a daily production capacity of 13,608 tons. Mining ceased in 1999; the mine was successfully reclaimed and is currently in post-closure care. There is currently no feasibility study for the Ridgeway Mine and no known estimate of gold reserves.

Bayberry Site

The Bayberry project is located approximately 2.5 miles northwest of the Haile Gold Mine. The first phase program is underway with 15 holes completed and assayed. Romarco has encountered mineralization beyond and below the limits of historical drilling and has drilled through the oxides and found gold mineralization in the sulfides. At this time, Romarco has not identified a resource on the Bayberry Site. The Bayberry target is located at the historic Brassington Mine, which had small production at the turn of the 20th century. In the 1980s, the project area saw limited drill testing by Amselco Exploration and Westmont Mining. A total of 14,760 feet of drilling were completed historically, predominately in shallow holes. Much like the 1980s exploration at Haile, prior exploration was predominately focused on oxide, heap leach material and the projects were abandoned when drilling encountered sulfide material. The host lithologies and alteration assemblages encountered at Bayberry are nearly identical to those at Haile. A second phase drill program is currently underway at Bayberry (Romarco 2012). There is currently no feasibility study for the Bayberry site.

Summary

The findings indicate that alternative locations for the Haile Gold Mine are not viable because the mine and pit locations are dictated by the location of ore grade mineralization that has been documented to contain mineable gold reserves. Through a Feasibility Study,[3] the Applicant has explored, identified, and evaluated proven gold reserves at the Haile Gold Mine site. No other locations with proven gold reserves—a necessity for a gold mine operation (as acknowledged in the overall project purpose)—are known in the Carolina Slate Belt. In addition, the alternative sites are privately owned and may not be reasonably attainable. Designation as a Superfund site would affect regulatory compliance for two of the sites (Barite Hill, Brewer). Due to the Superfund designation, both sites are understood to have other significant adverse environmental consequences and obstacles associated with new mining at these sites. A significant investment of labor and time would be required for further exploration to assess feasibility prior to mine development at an alternate location. Development costs are unknown, but are assumed to be of a similar amount to that expended at Haile.

Only the Haile Gold Mine location has the necessary feasibility study to demonstrate proven gold reserves (M3 Engineering & Technology Corporation 2010). Therefore, the Haile Gold Mine is the only site that can meet the Project purpose, and alternative sites will not be evaluated further in the Draft EIS.

[3] The *Haile Gold Mine Project NI-43-101 Technical Report Feasibility Study* (M3 Engineering & Technology Corporation) is referred to herein as the *Feasibility Study*.

2.5.2.2 Alternative Mining Methods

Open-Pit and Underground Mining

To determine the mining methods that could be used at the Haile Gold Mine site, the USACE considered the following;

- Is the concentration of gold in the ore at the Haile Gold Mine within the industry standard threshold for open-pit mining (0.01 to 0.13 ounces per ton)?
- Is the concentration of gold in the ore at the Haile Gold Mine within the industry standard threshold for underground mining (0.13 to 0.19 ounces per ton)?
- Are the concentrations of gold distributed in the ore at the Haile Gold Mine conducive to a combination of surface and underground mining?
- What would be the impacts on Waters of the U.S.?

Two general methods of ore extraction are used for gold mining: open-pit mining and underground mining. Open-pit mining is the most cost-effective method when the mineral-bearing ore has a low concentration of gold and a large volume of ore must be removed to extract economic quantities of gold. Underground mining methods are typically used where the concentration of gold in the mineral-bearing ore is relatively higher and smaller volumes of ore can be removed to yield economic quantities of gold. Underground mining methods are commonly ten times more expensive than surface mining methods (IGIE 2006). Although conventional underground mining results in little direct surface impact, it requires a high grade ore deposit to offset the high cost of mining. Underground mines require a larger labor force; small working areas; and installations of ground support, services (electric power, water, and compressed air), and ventilation. Production rates from underground mines are limited due to selective mining in order to maintain higher ore grade (IMC 2013).

The results of exploratory drilling at Haile Gold Mine indicate that the average concentration of gold is approximately 0.06 opt, with a minimum concentration cutoff of 0.01 opt for ore to be processed (M3 Engineering & Technology Corporation 2010). This low concentration is consistent with concentrations mined at other open-pit operations, such as the Round Mountain Mine in Nevada (0.018 opt) (Kinross 2012b) and the Fort Knox Mine in Alaska (0.013 opt) (Kinross 2012c). Open-pit gold mines worldwide typically have concentrations of gold from 0.03 to 0.13 opt (Gold Investing News 2013). The feasibility study completed in 1986 for the Ridgeway Gold Mine deposit proved the presence of a 51-million-ton reserve with a concentration of 0.038 opt.

Underground mines typically have gold concentrations that are much higher than open-pit mines, ranging from 0.13 to 0.19 ounce per ton of ore (opt) for marginal underground mines, and from 0.25 to 0.32 opt for higher quality mines (Gold Investing News 2013). An example of ore concentration from an underground mine in the United States is the Kettle River-Buckhorn mine in Washington, with a gold concentration of 0.35 opt (Kinross 2012a).

Although the average concentration of gold at the Haile Gold Mine is low, three of the reserves at the Haile Gold Mine are within the range of other marginal underground mines. Snake and Horseshoe[4] both

[4] Although Horseshoe is a resource, it was not included by Haile in the reserve pit. It is included in this underground analysis because it is potentially economical by underground methods. The Palomino and Mustang resources had not been identified through exploration drilling and therefore were not identified in the block model of the deposit that was used for the 2010 Feasibility Study, nor were they considered as part of the underground mine plan (IMC 2013).

have concentrations of 0.185 opt, and Ledbetter has a concentration of 0.15 opt. Haile developed a scoping-level underground mine plan for the Haile Gold Mine deposit (IMC 2013) to discover whether an underground mine would be feasible for any of the reserves at the site, either as a stand-alone project or in combination with open-pit mining. The underground mining method selected was blasthole stoping with delayed fill. A *stope* is the void that remains underground after ore has been mined and removed. Once the ore has been removed, the stope is filled with uneconomic rock or other fill material. Access to the underground mining areas was assumed to be via a vertical shaft, which enables access to the mine for workers, materials, and equipment; ventilation; and transportation of mined ore to the surface for processing. This type of underground mining requires contiguous zones of ore. Isolated blocks of ore grade are not practical or economical to develop because of the extensive capital costs to access each stope zone.

As noted earlier, production rates from underground mines are limited because of selective mining in order to maintain higher ore grade; small working areas; and the need to install ground support, services (electric power, water, and compressed air), and ventilation, among others. The production rate of 1,000 tons per day was selected as a reasonable target production rate for the underground mine plan based on the need to continually develop and prepare new production stopes as current stopes are exhausted.

An initial estimate of mining, processing, and overhead costs was used to set a minimum concentration of gold in the ore for underground mining. Only blocks above 0.1 opt of recoverable gold (0.118 opt in-situ) were deemed feasible, which resulted in five zones that potentially could be mined using underground methods. This shortlist was further reduced as small isolated pods with little tonnage were removed from the analysis because they would not offset the capital cost to develop. This left three zones for inclusion in the underground mine plan: Snake, Ledbetter, and Horseshoe reserves. The full identified open-pit reserve could not be recovered with underground mining.

The underground mine requirements, including shafts, drifts,[5] crosscuts, ventilation raises, and ore hoisting, were designed for these three reserves; and a schedule and cost analysis were prepared. At a target production rate of 1,000 tons per day (compared to 7,000 tons per day in the open-pit reserve alternative), the underground mine could continue for approximately 6 years, compared to approximately 14 years in the open-pit reserve alternative. Mine capital and operating costs were developed for the 1,000-tons-per-day mine plan and are included in the Independent Mining Consultants (2013) report. It was estimated that the underground mining alternative would generate revenue of approximately $324.0 million. Mining, processing and general and administrative costs (cash operating costs before reclamation) would equal approximately $205.8 million, and initial capital investment costs would equal approximately $205.9 million (Haile 2013a). This analysis shows that the costs of mining these deposits using underground methods would greatly exceed revenue, which demonstrates that the underground mining alternative is not practicable due to cost.

Due to the structural design requirements of an underground mine and the higher cost of extraction, underground mining, or a combination of open-pit and underground mining, were not considered to be practicable alternatives to the proposed Project. As such, underground mining was not considered for further analysis in the Draft EIS.

Underground mining would reduce impacts on Waters of the U. S. compared to open-pit mining. Due to less ore being extracted in the underground mining scenario, the total footprint for the OSAs and TSF

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[5] A *drift* is a horizontal opening in or near an ore body and parallel to the course of the long dimension of the deposit.

would be reduced compared to the open-pit reserve, and impacts on Waters of the U. S. would be reduced from no open pits. Because the underground mining alternative was determined to be neither reasonable nor practicable due to cost, comparative figures for possible impacts on Waters of the U.S. were not quantified. Table 2-4 summarizes the evaluation of alternative mining methods.

When evaluating mining methods, the USACE also considered expanding mining activity into areas of mineralization adjacent to the proposed mine pits using underground mining methods. The proposed extent and method of mining within the Project boundary is based on the Feasibility Study for the proposed Project. While mineralization does extend beyond the proposed mine pits, expansion of mining to these areas is not proposed nor included in the current Feasibility Study. Therefore, consideration of underground mining into areas beyond the reserves indicated in the Feasibility Study would be speculative. To the extent that Haile develops additional feasibility analysis of other mineral deposits within the Project boundary or beyond, and initiates plans to expand the mine operation, they would be required to undergo additional permitting reviews and environmental analysis at that time.

Table 2-4 Evaluation of Alternative Mining Methods

Potential Alternative	Ore Grade	Impacts on Waters of the United States
Open-pit mining	Most efficient mining method for ore with low gold concentration.	Direct effects to approximately 120.46 acres of wetlands and open waters and 26,460.54 linear feet of streams.
Underground mining	Grade of ore deposit not sufficiently high for underground mining method.	May reduce direct impacts on streams and wetlands.
Combination of underground and open-pit mining	Grade of ore deposit not sufficiently high for underground mining method.	May reduce direct impacts on streams and wetlands.

2.5.2.3 Alternative Pit Configurations

As with any large excavation, the slope of the side walls must be engineered to safely maintain their structural integrity. In the case of an open-pit mine, this includes vibratory loads caused by movement of heavy equipment and blasting during the excavation process. The volume of overburden and ore planned to be removed in the proposed Project is based on the independent Feasibility Study (M3 Engineering & Technology Corporation 2010) prepared for the Applicant as part of its mine planning process. The Feasibility Study included several development scenarios, each of which was tied to an assumed commodity price for gold.

As described in Section 1.5.7, the Applicant has determined as a matter of business prudence to base the planning for the Haile Gold Mine on a gold price of $950 per ounce (M3 Engineering & Technology Corporation 2010). The projected price of gold determines what grade of ore can be economically mined and processed. *Grade* is defined as the concentration of gold in a given volume of ore measured in ounces per ton. The grade of ore, in combination with engineering limitations based on the integrity of the material to be mined, determines the size and configuration of the production pits.

A detailed geotechnical and engineering analysis was performed at the Haile Gold Mine site to determine the rock strength and quality classification for strata overlying the ore body (Golder Associates 2010). The configuration of the pits in the proposed Project was determined based on the location and configuration of the ore body, the characteristics of the rock, the hydrogeology of the groundwater system, and the economic and operational variables determined in the Feasibility Study.

The pit configuration determines the location and shape of the pits, along with the bench size within the pits, access roads, pit wall slope angles, and layback phases. Design factors could be adjusted based on economic variables but must meet the current standard of care for safety, as defined by federal and state regulations (Golder Associates 2010). The recommended pit slopes were based on the available information from bore holes and represent a balance between maximum risk avoidance, such as requiring flatter slope angles and larger pits, and some risk of slope failure without jeopardizing the mine plan or worker safety. The pit engineering report indicates that steeper slope angles may be possible if actual conditions are found to be better than projected (Golder Associates 2010).

The USACE considered both larger and smaller pit size alternatives. At higher gold prices, larger and deeper pits would likely be economical because additional lower grade ore could be mined and processed. At a lower gold price, the pits may, but would not necessarily, be smaller because the lower price would reduce the amount of mineable reserves. Even if a reduced volume of mineable reserves were available because of the reduced gold price, extracting the gold would require removal of overburden over a similar pit area and likely would result in similar direct impacts. In addition, no matter what gold price is used in the mine planning process, the location of the ore body would require that the pits be in the same approximate location.

Alternative mine plans based on larger pits may be supported by higher gold prices. However, the increased pit size also requires increased overburden storage requirements. All of these changes in the mine plan would increase the amount of disturbed area within the Project boundary and would increase direct impacts on Waters of the U.S. Because the direct impacts associated with larger pits would be greater than those associated with the proposed Project, larger pit configurations were not considered as an alternative to be considered in further detail in the EIS.

Two smaller pit configurations were considered:

- Smaller pits – reduced volume of ore removal with similar design criteria (same slopes)
- Smaller pits – same volume of ore with revised design criteria (steeper slopes)

Table 2-5 summarizes the evaluation of the smaller pit configuration alternatives.

Table 2-5 Evaluation of Smaller Pit Configuration Alternatives

Potential Alternative	Practicability	Impacts on Waters of the United States
Smaller pits – reduced ore volume with same design criteria.	Would not allow mining of the identified reserves. Construction methods similar to proposed Project, but yield of ore to be processed would be reduced, making the project nonviable.	Could reduce direct impacts on Waters of the U.S. by reducing the pit footprint.
Smaller pits – same ore volume with revised design criteria.	Practicability uncertain; may not be technically feasible. Steeper pit slopes may not meet engineering and safety standards. Use of steeper side wall slope design would depend on actual conditions encountered once mining has commenced.	Could reduce direct impacts on Waters of the U.S. by reducing the pit footprint.

Both smaller pit alternatives may reduce direct impacts on Waters of the U.S. by reducing the pit footprint. Smaller pits based on a smaller volume, however, would not allow mining of the identified reserves. The pit configurations developed for the proposed Haile Gold Mine were optimized through a detailed evaluation of the ore deposit geology, geometry, and metallurgy, in addition to economic factors such as commodity prices and operating costs for various processing options. The USACE determined that deviation from the optimized design in the number of pits or sizes of pits would directly affect the amount of mineral reserve recovered and thus would not meet the overall project purpose.

Smaller pits achieved by steeper slopes may not be technically feasible or safe. Use of a steeper side wall slope design may be possible but would depend on actual conditions encountered once mining has commenced. The pit wall configuration under the current design balances risk with safety, based on the available information and prudent engineering practices. Steeper pit slopes may not meet engineering and safety standards; therefore, the practicability of the alternative is uncertain. For these reasons, neither of the conceptual smaller pit configuration alternatives was found to be practicable, and smaller pit configurations were not considered as an alternative to be discussed in further detail in the Draft EIS.

2.5.2.4 Alternative Ore Processing Methods

Ore produced at the Haile Gold Mine does not include any measurable quantities of “free” gold (gold that could be recovered using mechanical separation methods.) Consequently, the ore must be processed using methods suitable for the type of ore present at the Haile Gold Mine.

Treatment typically consists of:

- Crushing and grinding to reduce the ore particle size to sand-like material;
- Leaching of the finely ground ore that dissolves the gold into a liquid solution;
- Precipitation of the gold out of the leach solution with activated carbon electro-extraction; and
- Smelting to remove impurities.

The gold processing methods described in the proposed Project conform to industry standard practices and were vetted in the Feasibility Study as having “no unproven technologies”; the size of the facilities is similar to other facilities constructed in the past (M3 Engineering & Technology Corporation 2010).

While a variety of types of equipment may be used for crushing and grinding, they generally result in the same type of finely ground material that enters the leaching and precipitation process. No practical alternatives to the crushing and grinding process were identified. In addition, alternative crushing and grinding methods would not reduce direct impacts on Waters of the U. S. or reduce potential impacts on other resources.

The leaching process has two components: the chemicals and media selected for leaching, and the physical configuration of the leaching process. The use of cyanide as a leaching agent is the industry standard practice for commercial gold ore processing (referred to as *cyanidation*). Alternatives to cyanide that have been tested include thiourea, thiocynate, thiosulphate, bromine, chlorine, and iodine. None of these alternatives has been demonstrated to be viable for ore processing on a commercial scale (Hendrix 2005); comparatively, cyanide can be considered the best available technology for gold extraction (IGIE 2006).

The USEPA, with Purdue University, developed a risk-based assessment scheme that took into account various environmental, toxicity, and worker-related data for a long list of chemicals that are widely used throughout the world (Eurostat 2010). From the data, cumulative risks to the environment and workers were tabulated for each reagent/process presented as a substitute for cyanide, and cyanide was rated as the overall lowest risk (Eurostat 2010).

A number of different gold extraction techniques exist, but conventional cyanidation remains by far the most widely used technique because of its cost effectiveness. Added to this, many of the alternative leaching techniques pose equal or greater risks to the environment (Eurostat 2010).

In a modern mining project, the largest portion of the cyanide is consumed as a result of the chemical transformations during ore processing in the plant. The quantity of cyanide that remains in the process tailings would be neutralized using a modern and efficient oxidation process. This process has been used in more than 80 mines worldwide over the last 30 years. After neutralization, the tailings with low cyanide content are stored in a specially designed tailings management facility, where the cyanide concentration would be further reduced. Cyanide naturally degrades when exposed to air and natural light.

Cyanide can be recovered and re-used by recycling cyanide-containing solutions within the metallurgical circuit. This is commonly conducted using thickeners or filters to separate solution from tailings, with the solution being recycled to the grinding and/or leaching circuits.

It has been recommended that this approach be evaluated by all mining operations using cyanide because of its simplicity and effectiveness; however, this method cannot be the complete solution to cyanide removal requirements. Cyanide destruct technology is used when needed to achieve lower concentrations in tailings slurry discharges.

Recovery of cyanide from tailings by means of internal recycling is a process that is economical and environmentally desirable, because it reduces the cyanide input for the processing plant and the chemical reagent and energy consumption in the destructive treatment process for cyanide. Recycling of cyanide in a metallurgical circuit rather than discharging it to the tailings pond is therefore the best available technique according to the *Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities* (European Commission 2004).

The Applicant proposes to use the internal recycling techniques described above. Cyanide would be present only in the closed-loop process water used at the Mill, and most of it would be recycled in the leaching circuit. Under normal operating conditions, leached tailings from the Mill would be pumped to the Duckwood TSF. If the cyanide level is greater than or equal to 50 parts per million (ppm) weak acid dissociable (WAD) cyanide, the tailings flow would be directed to the cyanide destruction tanks, where cyanide levels would be reduced to below 50 ppm WAD cyanide using a sulfur dioxide and air process. In the Duckwood TSF, ultraviolet (UV) sunlight and air would naturally decompose the remaining cyanide and cyanide complexes to further decrease cyanide levels.

Of the four steps in ore processing, the only steps where alternative technologies are potentially available that may affect the potential impacts of the Project—particularly direct impacts on Waters of the U.S.—are the leaching technology and the process for precipitation of gold for smelting. Alternative components to this process include:

- Leaching facilities
- Separation of high-sulfur tailings
- Pressure oxidation processing
- Concentrate roasting

Alternative Leaching Facilities

Under the proposed Project, the leaching and precipitation processes would take place in large aboveground tanks, where all finely ground ore, leaching chemicals, active carbon, and other materials would be contained and isolated from the environment. Further, all tanks would be placed within a containment structure to control and contain any spillage in the event of a tank failure.

While alternative arrangements for the tank processing facility are possible, the potential direct impacts on Waters of the U.S. associated with the proposed Project have been minimized by a compact facility design that is oriented to avoid wetlands and streams. Further, the leaching process has been optimized to minimize the use of cyanide through cyanide recovery and recycling.

The types of processing facilities used for cyanide leaching have implications for the environmental effects of the proposed Project, and alternatives are available for consideration. Cyanide leaching can be conducted in vats or tanks as proposed by the Applicant, or in large open pits or "heaps." Although heap leaching (Figure 2-4) was used in the late 1980s for gold extraction at the Haile Gold Mine site, it is more frequently used in the western United States and in more arid climates.

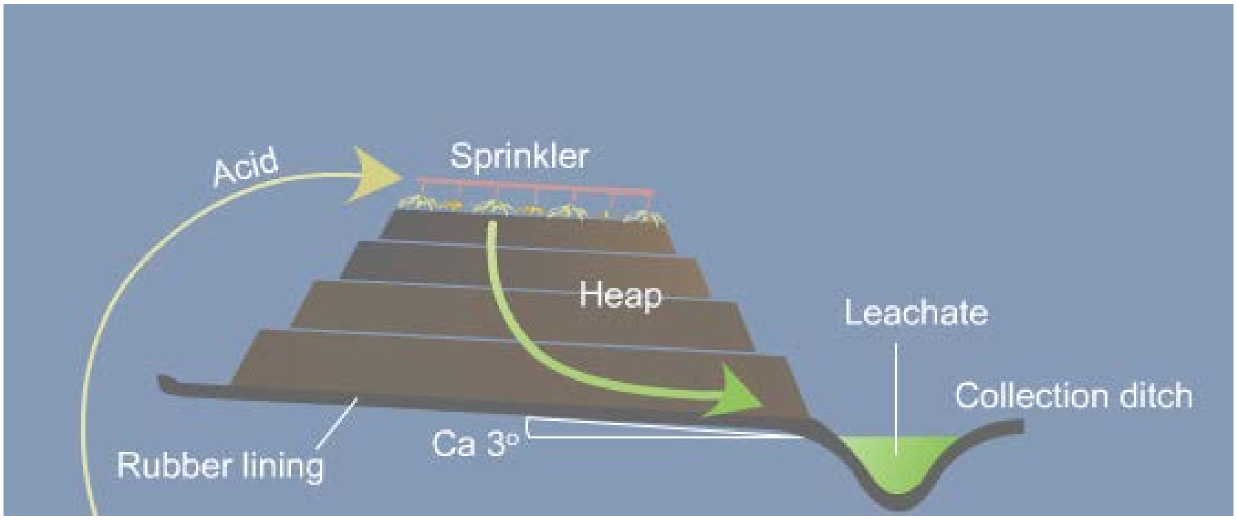

Figure 2-4 Heap Leaching Schematic

Note: Ca 3° indicates a slope of 3 degrees.

Source: Bauer 2007.

In heap leaching, sodium cyanide is used as the leaching reagent for extracting gold. Although heap leaching can be less expensive than processing the ore in tanks, it is not proposed for use in the Project because of several drawbacks. These include the following:

- The layout of the current mine plan leaves little area free of wetlands or stream courses and their buffers. The land area for the heaps would require encroachment on wetlands and would increase direct impacts on Waters of the U.S.
- Open heap leaching systems increase the risk of environmental exposure to cyanide.
- Heap leaching is less efficient at extracting gold than the tank system.
- Humid climates pose challenges in managing cyanide levels and water balance for an open-air heap leach pad.

Separated Tailings Streams and Separated High-Sulfur Tailings Storage

Under the proposed Project, the tailings produced from the gold ore processing would include residual sulfide minerals, and these would be accumulated in the Duckwood TSF. Sulfide minerals present in the tailings would consist mainly of pyrite, which has the potential to generate acid if exposed to oxygen and precipitation. During mine operation, these tailings would be actively managed as part of the lined TSF facility and the closed-loop process water cycle. After closure of the TSF, the tailings would be capped and drained over a period of several years.

The proposed TSF would be constructed for the long-term protection of the tailings during operation and after closure, and to prevent their exposure to the atmosphere and water. Even when protected by the engineered containment and closure measures, the tailings may become exposed to air and water because of accident or long-term degradation, and may result in acid mine drainage.

The USACE evaluated alternative tailings processing and storage management that involved separating the sulfide minerals from the tailings at the Mill Site and separately storing high-sulfur and low-sulfur tailings. Under this alternative, a processing facility would be added at the Mill Site to separate the tailings. Separation would result in two tailings streams: one with high-sulfur tailings (30 percent total sulfur) and one with low-sulfur tailings (0.19 percent total sulfur). In comparison, tailings in the single TSF under the proposed Project would have 3 percent total sulfur (AMEC 2012a).

After separation, the high-sulfur tailings would need to be stored in a separate, independent TSF or in a partition within the existing proposed TSF (Figure 2-5). The higher sulfur tailings would need to be permanently maintained in a saturated, anoxic condition to prevent the formation of acid. This would require installing a more complex lining and drainage system, monitoring water levels to ensure that the tailings were covered to the required depth regardless of climatic conditions, and monitoring for acid formation (AMEC 2012a).

Segregation of the tailings may allow lower overall environmental risk by isolating the smaller volume of higher sulfur content tailings in an appropriate but smaller TSF. However, unintended release of high-sulfur tailings poses a greater environmental risk than a release of the combined tailings because of the higher potential of the high-sulfur tailings for acid generation and their ability to dissolve metals (Schafer Limited 2012). In addition, a separate storage facility for high-sulfur tailings would require development of an additional 80 acres, which would result in additional direct impacts associated with the increased area to be disturbed.

Separating the tailings also would allow higher sulfur tailings to be sold as a commercial product. As a byproduct, the sulfide mineral concentrate might also be used to supplement the pressure oxidation and roasting processes of mine operators in other regions. The sale and use of the byproduct sulfide concentration would be subject to the availability of a willing buyer and surface transportation costs. The Applicant investigated the market for sulfide concentrate and found no demand for the product, particularly since the concentrate would likely have remnant amounts of metals, arsenic, and cyanide (M3 Engineering & Technology Corporation 2012). It seems unlikely in the near term, therefore, that the sale of the sulfide concentrate would yield any additional revenue for the mine.

The Applicant estimated the additional costs to the Project for tailings separation and for combined and separate storage of tailings, as shown in Table 2-6.

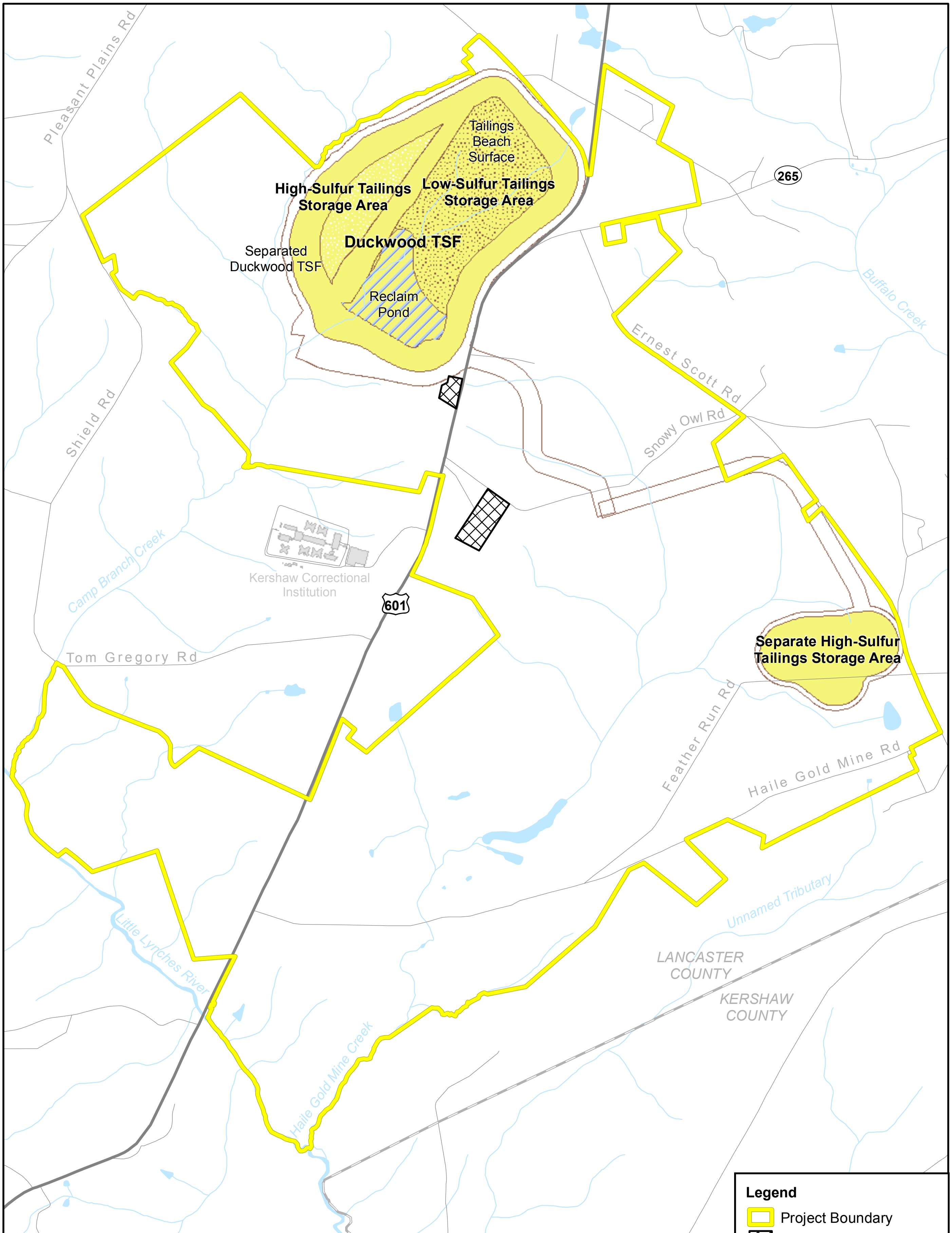

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Figure 2-5
Alternative Storage Facilities for Separated Tailings Streams

0 1,000 2,000 Feet
0 300 600 Meters

Sources: AMEC 2012, ESRI 2008.

Table 2-6 Comparison of Additional Costs of Separated Sulfide Concentrate Tailings Streams

Cost	Duckwood Comingled Tailing Storage As Proposed	Duckwood with Separate High- and Low-Sulfur Tailings Storage	Stand-Alone Facilities for Separate High- and Low-Sulfur Tailings Storage
Tailings storage facility construction costs	$140 million	$157 million	$137 million ($48 million for high-sulfur facility and $89 million for low-sulfur facility)
Additional equipment for processing	0	$22.3 million	$22.3 million
Shipping facility	0	$8 million	$8 million
Additional land area	0	0	80 acres
Total capital costs	$140 million	$187.3 million	$167.3 million
Additional operating costs (processing and shipping)	0	$3.3 million	$3.3 million

Sources: AMEC 2012a; M3 Engineering & Technology Corporation 2012.

Separation of tailings would increase Project capital costs to approximately $187.3 million for combined storage in a single enlarged Duckwood TSF and by $167.3 million for storage of high- and low-sulfur tailings in separate TSF facilities. Under either separated TSF configuration, annual operating costs for the mine would increase by approximately $3.3 million per year compared to the proposed Project.

In summary, separating the tailings stream and providing for separate storage is not a practicable alternative for reasons of cost alone. Furthermore, this alternative would not reduce direct impacts on Waters of the U.S. With no demonstrated market for the sulfide byproduct, a separate TSF for high-sulfur tailings storage would need to be maintained for the same amount of time as the proposed single TSF. Unintended release of high-sulfur tailings poses a greater environmental risk than a release of the combined tailings because of the higher potential of the high-sulfur tailings for acid generation and their ability to dissolve metals (Schafer Limited 2012). In addition, separation of the high-sulfur tailings would require disturbance of an additional 80 acres of land.

Pressure Oxidation Processing

Instead of producing PAG tailings, the ore could be processed using an alternative pressure oxidation technique that would result in higher gold and silver recovery and neutralized sulfide minerals (M3 Engineering & Technology Corporation 2012). Other pressure oxidation systems in operation provided data for comparison purposes. The additional capital costs to build the pressure oxidation processing facility were estimated at $135 million, and the increase in net annual operating costs was estimated at $14 million. The proposed TSF may need to be enlarged to hold the tailings with the acid-neutralizing lime additions, causing an increase in the disturbed area footprint for the TSF. While this process would likely enhance gold recovery, the amount has not been estimated. The alternative pressure oxidation technique is not a practicable alternative since it would not reduce direct impacts on Waters of the U.S., would be very costly, and could require disturbance of additional land if the proposed TSF needed to be enlarged.

Concentrate Roasting

Following initial processing of the ore, the proposed Project includes a flotation process to concentrate gold particles prior to the carbon-in-leach process. An alternative processing method would use a high-temperature roasting process to accomplish ore concentration (M3 Engineering & Technology Corporation 2012). This method has been used at one U.S. site at the Barrick Goldstrike mine in Nevada but has not been frequently used elsewhere. The process produces off gas emissions from the roasting process that would require treatment prior to release. The treatment process would require different equipment and would produce substantial quantities of sulfuric acid (600–800 tons per day) that would need to be sold or neutralized.

The additional treatment equipment for this process is estimated to cost an additional $177 million in capital costs and $7.3 million per year in operational costs. The process would marginally improve the gold and silver recovery rate, which may offset a portion of the increase in operating costs. Increased gold recovery is estimated at an additional $9.5 million per year based on a market price of $950/ounce for gold and $20/ounce for silver. Acid sales are uncertain as the market fluctuates and there is less demand for acid with impurities. Material produced is valued at $12.8 million per year if it could be sold; potential costs to neutralize the 600–800 tons of acid generated per day are estimated at between $17.5 and $23.3 million per year (M3 Engineering & Technology Corporation 2012). Concentrate roasting would not reduce direct impacts on Waters of the U.S.; direct impacts would be the same as under the proposed Project if the additional facilities could be constructed within the same proposed facility footprint.

Evaluation of Ore Processing Alternatives

Only heap leaching would likely meet the overall Project purpose; the other ore processing alternatives (separated tailings, pressure oxidation, and concentrate roasting) would not be economically viable or practicable because of significant increases in Project cost and, in the case of concentrate roasting, unproven technology. Heap leaching and separation of high-sulfur tailings would require disturbance of additional land; this would likely increase, not decrease, direct impacts on Waters of the U.S. In addition, because no market for the high-sulfur tailings has been identified, they would likely require long-term storage and involve a storage facility with similar or higher environmental risk. Concentrate roasting would not only increase Project costs but also would create byproduct streams with environmental risk, with no corresponding reduction in direct impacts on Waters of the U. S. Based on this evaluation, none of the ore processing alternatives were further evaluated in the Draft EIS.

2.5.2.5 Alternative Mill Sites

The Mill Site, including the chemical storage area, contact water treatment plant, equipment maintenance shop, fueling station, and main offices, were co-located to increase operational efficiency and to reduce the Project footprint. Because the distance from the Mill Site to the pits and TSF affects the cost to transport the ore and the tailings, the facility is placed close to the pits under the proposed Project. Centrally locating the Mill Site also reduces traffic and safety risks related to hauling ore.

The location and configuration of the Mill Site in the original mine plan were based on the general mine configuration, the property owned by the Applicant at the time the plan was developed, and access to a public road. Since that time, the Applicant has acquired additional property and changed the configuration of the Mill Site. This reconfiguration has reduced direct impacts on Waters of the U.S. by 10.51 acres of wetlands and 1,294.31 linear feet of stream, minimizing direct impacts associated with the site itself (Haile 2012c). Figure 2-2 shows the configuration of the Mill Site in the August 2012 revised DA permit application.

Although direct impacts on Waters of the U.S. are associated with the Mill Site haul road (1.0 acre of wetlands and 471.5 linear feet of streams) and the TSF haul road (2.2 acres of wetlands and 614.5 linear feet of streams), direct impacts from the Mill Site have been minimized. (See Section 2.6.2.9 for discussion of haul road alternatives.)

2.5.2.6 Alternative Overburden Storage Areas

During mine development, the Applicant configured and located the OSAs in response to several design criteria, including:

- Locating OSAs adjacent to the mine pits to minimize the distance over which overburden needed to be moved;
- Optimizing the footprint to minimize disturbed acreage;
- Maintaining slopes no steeper than 3:1;
- Limiting total height to 200 feet or less; and
- Classifying overburden based on acid generation potential.

Estimates of overburden storage requirements and reclamation use under the proposed Project are shown in Table 2-7. Permanent overburden storage would result in an aboveground topographic feature (a large mound of earth contoured to reflect the surrounding topography).

Table 2-7 Estimates of Overburden Storage Requirements and Reclamation Use under the Proposed Project (million tons)

Material	Johnny's PAG	Pit Backfill	Overburden Storage Area Net Storage	Tailings Storage Facility Construction	Total
Green Class PAG	0	37.2	64.0	6.0	107.2
Yellow Class PAG	8.3	19.1	0	0	27.4
Red Class PAG	24.5	0	0	0	24.5
Sap rock	3.0	9.0	37.0	1.4	58.5
Sand/other	0.7/5.8	1.1/0.3	13.8/0.9	1.1/0	16.7/7.0
Total	**42.3**	**66.7**	**117.6**	**14.7**	**241.3**

PAG material = potentially acid-generating material.

According to the mine plan, approximately 241 million tons of overburden would be removed from the pits and temporarily or permanently stored in one of seven separate OSAs. As described in Section 2.2, the overburden is expected to consist of three general types of material, depending on its potential to generate acid; and would be classified, segregated, and managed accordingly. Placement of overburden for temporary or permanent storage is programmed based on the pits in operation, as shown in Table 2-1.

The distribution among the various classes of potential acid generation (designated by the Applicant as Green Class, Yellow Class, and Red Class) (Haile 2012d) was based on the Applicant's evaluation of the subsurface geology determined by its minerals excavation program. It is expected that volumes would vary to some extent during actual mining.

Under the proposed Project, approximately 61 million tons (25 percent) of the excavated overburden would be used during mining to backfill some of the pits. The presence of some sulfides in overburden material requires that one OSA be dedicated to storage of material that could potentially generate acid mine drainage. As described in Section 2.2.4, Johnny's PAG has been dedicated for this purpose. During consideration of alternatives, the addition of lime to Red Class overburden was identified as a potential means to balance the pH of the Red Class overburden. However, Johnny's PAG would be constructed with a liner below the fill and would be capped after completion of mining, isolating the PAG material and minimizing the long-term potential for acid generation. With these preventive measures in place, Haile does not propose to introduce a lime additive to neutralize Red Class overburden. Because there is no expected release of acid mine drainage, the addition of such material would not measurably reduce potential impacts.

The following alternatives were considered for overburden storage and are discussed below:

- Modifications to the design criteria (steeper slopes, increased heights)
- Alternative location or configuration of the OSAs
- Changes in the volume of overburden as backfill in the pits

Design Criteria for Overburden Storage Areas

Changes in the design criteria that allow steeper slopes or increased storage area heights may reduce the footprint of the proposed OSA and reduce direct impacts on wetlands and streams. OSAs constructed with steeper slopes could hold more material without increasing the footprint. Mine regulations (89-140.B[5]) state that permanent overburden material needs to blend in with the natural landscape, which may limit the final configuration of the OSAs. According to the following information submitted by the Applicant describing their alternatives analysis, the criteria used to design the OSAs were optimized:

> *Side slopes have been established at the steepest angle (no greater than 3:1) and height determined to be safe, stable, economically feasible and suitable for handling reclamation and re-vegetation while at the same time meeting a beneficial post mining land use. The configuration of maximum side slope steepness and stockpile height minimize the required footprint of the stockpile and associated disturbance to Waters [of the United States]. Geotechnical investigations have been conducted to ensure these configurations maintain a stable foundation and side slope to prevent potential landslides.* (ERC 2011)

The engineering design configuration of slopes and height are regulated by the State of South Carolina and will be reviewed during Project final design. Consequently, changes to design criteria for the OSAs were not considered further as an alternative.

Locations and Configurations of Overburden Storage Areas

During mine development, the Applicant minimized impacts on Waters of the U.S. by designing multiple OSAs rather than a single large facility, even though a single facility is more typical and cost effective (ERC 2011). In August 2012, the Applicant submitted a revised mine layout that further minimized direct impacts on wetlands and streams by reconfiguring three OSAs. Hayworth OSA was split in two parts (renamed Hayworth and Robert OSAs), James OSA was moved, and the boundaries of Hilltop OSA were adjusted. Projected direct impacts on Waters of the U.S. remain for two haul roads (Robert and James OSAs) serving these facilities (Haile 2012b).

The USACE reviewed the configurations of other OSAs (Johnny's PAG, Ramona OSA, and 601 OSA) to determine whether direct impacts on wetlands and streams could be reduced by further reconfiguring or reducing the size of these OSAs. In each case, reconfiguring or reducing the size of the OSA would require an increase in the size of one or more of the other OSAs, or would require creating a new OSA to accommodate the displaced overburden. There is insufficient space within the Project boundary to create a new OSA without affecting undisturbed wetlands and streams.

The Holly and Hock TSF borrow areas, located adjacent to the TSF, also were reviewed as potential placement areas for overburden. As part of the proposed mine plan, these borrow areas would provide material to be used in construction of the TSF berm. These areas contain soils and rock with the appropriate characteristics needed for constructing the TSF. The borrow areas were located and configured to avoid direct impacts on streams and wetlands. After the borrow material had been removed to construct the TSF, the disturbed areas would be reclaimed. Alternatively, the disturbed borrow areas also could be used as OSAs. An estimate of the overburden storage capacity of the Holly and Hock TSF borrow areas is shown in Table 2-8.

Table 2-8 Estimated Overburden Storage Capacities of Holly and Hock TSF Borrow Areas

Area	Replacement[a]	Overburden Storage[b]	Total
Holly	1,212,000 cy 1,900,000 tons[c]	4,437,500 cy 7,100,000 tons	9,000,000 tons
Hock	2,854,000 cy 4,600,000 tons	5,875,000 cy 9,400,922 tons	14,000,000 tons
Total	-	-	**23,000,000 tons**

[a] Replacement of material removed for construction of the Duckwood Tailings Storage Facility (TSF).

[b] Additional material stored, assuming a 3:1 slope design.

[c] Assumes approximately 1.6 tons per cubic yard (cy).

Use of the Holly and Hock TSF borrow areas for overburden storage would provide approximately 23 million tons of overburden storage. This could allow for (1) elimination of the 601 OSA; (2) a reduction in the size of Johnny's PAG; or (3) a reduction in the size of the Ramona OSA. Each of these options was evaluated in terms of the reduction in the amount of direct impacts on wetlands and streams that would occur at these OSAs, as shown in Table 2-9.

Table 2-9 shows that reconfiguration of the Ramona OSA would eliminate direct impacts on wetlands and streams for this Project feature and would substantially reduce the linear feet of streams affected by the Project. Reconfiguration of the Ramona OSA would reduce impacts by 7,111 linear feet of streams and 2.22 acres of wetlands, resulting in an approximately 26.8 percent reduction in direct impacts on streams and a 1.8 percent reduction in direct impacts to wetlands. Conversely, elimination of the 601 OSA by approximately 3.3 acres would result in an approximately 3 percent reduction in the total wetland areas directly affected by the proposed Project. Relocation of Johnny's PAG to the Holly/Hock TSF borrow areas would reduce direct wetland impacts by approximately 7 percent and would require construction of a second lined facility for management of acid generating waste. Therefore, modifying the Ramona OSA would afford the greatest reduction in impacts on wetlands and streams, in addition to the reductions already created by Haile.

Table 2-9 Potential Avoidance of Waters of the United States by Reconfiguration of Overburden Storage Areas

Overburden Storage Area	Capacity (million tons)	Active Use	Alternative Configuration	Waters of the U.S. Directly Affected	
				Proposed Project	Modified Alternative
Ramona OSA	60.0	Production Years 1–7	Storage capacity reduced by approximately 38% to avoid disturbance of streams and wetlands	7,111 linear feet 2.2 acres	0 linear feet 0 acres
601 OSA	7.2	Production Years 1–7, then reclaimed to zero storage	Eliminate	3.3 acres	0 acres
Johnny's PAG	41.4	Production Years 3–13	Reduce capacity by 50% to avoid disturbance of wetlands	13.0 acres	7.0 acres

Note: Total proposed direct wetland disturbance for the Applicant's Proposed Project = 120.46 acres; total proposed direct stream disturbance = 26,460.54 linear feet.

The modified configuration of the Ramona OSA, with a storage capacity of approximately 37 million tons, is shown in Figure 2-6. The disturbance footprint of the Ramona OSA as proposed by the Applicant would be approximately 165.2 acres, whereas the disturbance footprint of the modified Ramona OSA would be approximately 117.8 acres.

Relocation of approximately 23 million tons (or 38 percent) of the projected overburden storage capacity of the Ramona OSA would increase some Project costs for the Applicant. Preliminary estimates of these costs are as follows:

- Increased capital costs for equipment (four additional haul trucks and support equipment), haul road construction and maintenance = $12,000,000.
- Increased operations costs for operation of haul trucks during Mine Years 3 and 6 and support equipment = $11,300,000.

From an initial review of preliminary information, the USACE has determined that reconfiguring the Ramona OSA and using the Holly and Hock TSF borrow areas for overburden storage would meet the overall Project purpose and may be practicable. Therefore, this alternative is discussed in detail in the EIS as the Modified Project Alternative.

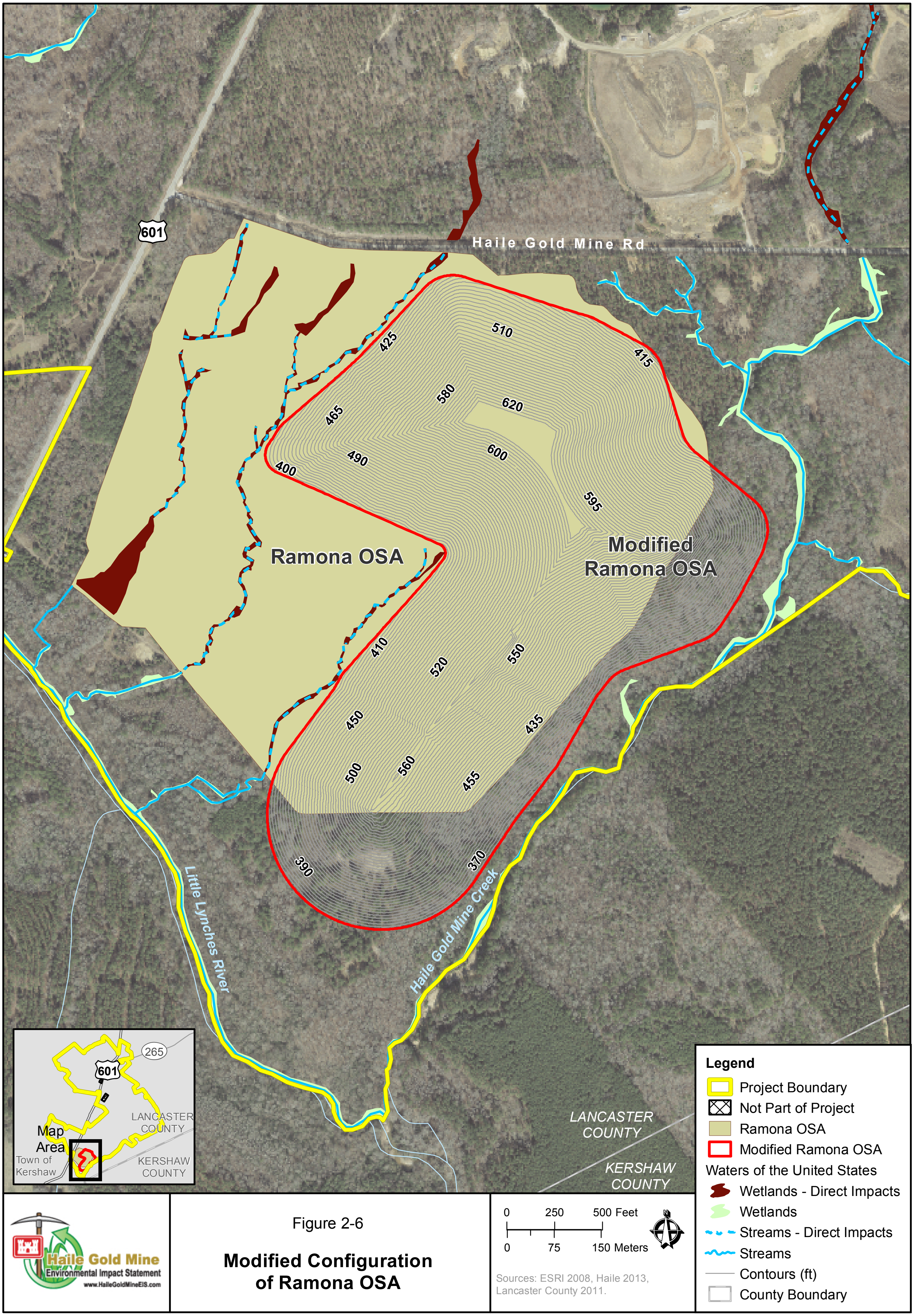

Figure 2-6

Modified Configuration of Ramona OSA

Overburden as Pit Backfill

The USACE analyzed alternatives involving more or less overburden placed in pits as backfill. One alternative that was considered was not backfilling any of the pits. This would require distributing the 58 million tons of overburden scheduled to backfill the pits across existing, expanded OSAs and constructing a new OSA near the TSF in the Camp Branch Creek drainage (Genesis Consulting Group 2011). This alternative would likely affect an additional 48 acres of Waters of the U.S., and would result in substantial increases in cost and emissions from hauling the material to the additional OSA site.

Another alternative that was considered was backfilling all of the pits. In the proposed Project, three of the pits would not be backfilled, and one pit would be partially backfilled. The final pit to be mined is the largest and deepest—Ledbetter Pit. The mined overburden from this pit would need to be stored in OSAs, as the other pits would have been backfilled by the time mining is completed in the Ledbetter Pit. Therefore, Waters of the U.S. already would have been disturbed, even if the material were subsequently moved from the OSA back into the pit.

Based on the capacity of the mining fleet, it would take approximately 8 years to move the 163 million tons of overburden to backfill the Ledbetter and Snake Pits (ERC 2012). This alternative is not financially viable or practicable given the scale of the effort and large additional cost—especially because it would extend mining activity well beyond completion of gold production. Backfilling all of the pits also would result in a considerable increase in diesel engine emissions. Finally, backfilling pits often makes future mining of ore and future reserves under that backfilled pit impracticable, thus foreclosing the possibility of future expansion or development of gold resources (ERC 2012). The Applicant has identified additional gold resources deeper than the bottom of the Ledbetter Pit (Figure 1-7).

Because of the scale of the effort, increased cost, and foregone possibility of future expansion or development of gold resources, the USACE did not consider this alternative practicable. It is not discussed further in the EIS.

Processing Overburden as Sand and Gravel

The USACE considered the alternative that Green Class waste rock and overburden could be used for commercial sand and gravel applications, possibly as aggregate for road building of other applications. This alternative would require additional processing of the material (crushing, grading, and storage) and availability of a commercial market. Sand and gravel used in road construction by the SCDOT or county road departments would need to meet specific engineering criteria regarding particle size distribution.

The addition of sand and gravel processing equipment would require disturbance of additional area within the Project boundary. The storage of green overburden has already been configured to minimize impacts on waters of the U.S.; therefore, reduction in environmental disturbance and impacts is unlikely to occur. In addition, Project capital and operating costs would be increased.

Four sand and gravel mines are in the vicinity of Kershaw, and 14 are within South Carolina (MASC 2014), mostly clustered around the urbanized areas where construction demand is greatest. Because the number of viable sand and gravel operations may already be sized to the market, there is no assurance that Haile could dispose of green overburden to the commercial sand and gravel market economically. If the market were not able to absorb Haile's production, material would need to be stored within the Project area, which is counterproductive to the intended purpose. Because of the increased costs, unlikely environmental benefits, and market uncertainty, reprocessing green overburden into commercial sand and gravel was not considered a practicable alternative, and it is not discussed further in the Draft EIS.

2.5.2.7 Alternative Tailings Storage and Management

Construction and operation of the proposed TSF would result in permanent conversion of 524 acres for construction of the TSF and temporary disturbance to 174 acres at the adjacent Holly and Hock TSF borrow areas, where material would be excavated and used in construction of the TSF. These areas combined represent one of the largest areas of disturbance in the proposed Project. Unlike certain other facilities within the mine, the TSF is not constrained to a particular location and could be located adjacent to or at some distance from the Mill Site that is the source of the tailings. The Applicant states that mine development sought to minimize the distance between the processing facility and the TSF in order to minimize the energy and cost required for transport, minimize the risk of spills and accidents, and optimize the use of land—in addition to other considerations related to the human and natural environment.

Alternative Sites for the Tailings Storage Facility

During mine development, the Applicant conducted a search for potential TSF sites within a broad area around the Haile Gold Mine—a radius of approximately 7 miles (ERC 2011). Because the TSF is a sizable impoundment of semi-liquids and solids, alternative TSF locations were first identified by seeking either topographic features that could facilitate construction of a ring dike embankment or a cross-valley embankment that could contain 15–40 million tons of tailings (ERC 2011; Haile 2012b). Based on these criteria, the Applicant identified 21 potential TSF sites.

The 21 potential TSF site alternatives then were screened using the following three criteria (AMEC 2012b; Haile 2012e):

- Direct wetland impacts no greater than 60 acres (using the proposed Project direct impacts of approximately 60 acres for the TSF as a benchmark);
- Capacity to permanently store up to 40 million tons of tailings; and
- Located within approximately 3 miles of the Mill Site to minimize transportation and operational costs.

Six of the alternative sites (Sites 3, 6, 7, 8, 9, and 11) were found to meet all three criteria and passed the Applicant's second screen. Table 2-10 presents the results of the Applicant's TSF alternative site screening, and Figure 2-7 shows the locations of the 21 alternative TSF sites in the Project area.

Multiple Tailings Storage Facility Sites

In addition to constructing a single TSF of 40-million-ton capacity, the Applicant evaluated constructing multiple smaller facilities to obtain the same amount of tailings storage. Because of physical and engineering constraints, two or more smaller facilities with a combined capacity of 40 million tons of storage would require a larger overall disturbed area than a single, larger facility. In addition, each separate facility would require its own containment dike and supporting facilities (drains, ponds, and borrow areas to construct the embankments). Duplication of the facilities and the initial construction of multiple embankments would increase the total area of disturbance for permanent tailings storage. In addition, multiple facilities would increase the risk associated with operation, maintenance, and site closure—and would increase construction and operation costs.

Table 2-10 Applicant's Screening Results for Alternative Tailings Storage Facility Sites

Alternative Site	Total Wetland Disturbed – Less Than 60 acres (acres)	Distance to Plant Site – Less Than 3 miles (miles)	TSF Capacity – at Least 40 Million Tons (tons)
1	141	4	30
2	36	3.7	15
3	51	1.5	40
4	142	1.5	30
5	154	1.7	15
6	49	1	40
7	33	0.6	40
8	53	1.6	40
9	53	0.4	40
10	87	1.7	30
11	35	2.6	40
12	117	3.5	30
13	224	3	15
14	181	5.7	15
15	5	2	28
16	11	1.8	14
17	70	0.4	30
18	29	0.3	30
19	30	0.9	30
20	4	1	5
21	18	1	14

Note:

Values in ***bold italics*** meet the screening criteria: direct wetland impacts no greater than 60 acres, within approximately 3 miles of the Mill Site, and capacity for 40 million tons of tailings.

Source: Haile 2012b.

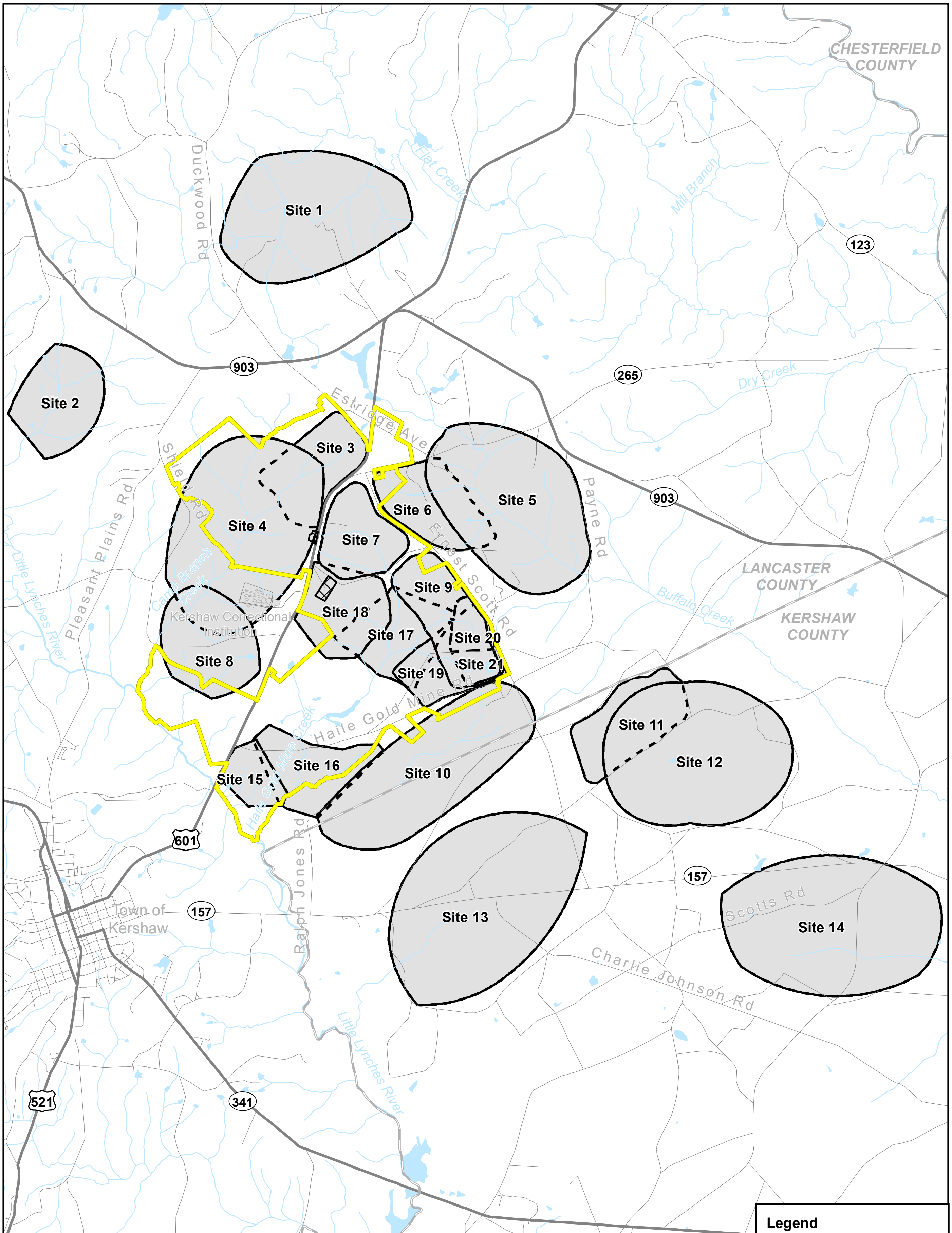

Figure 2-7

Locations of Alternative Tailings Storage Facility Sites 1–21

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Sources: AMEC 2012, ESRI 2008.

Legend
- Project Boundary
- Not Part of Project
- Alternative TSF Sites
- County Boundary

Note: Overlapping alternative TSF sites are shown with dashed lines to differentiate boundaries.

The six alternative TSF sites that passed the Applicant's initial screening (Site 3 [the proposed Project] and Sites 6, 7, 8, 9, and 11) were reconfigured to smaller TSFs with 20 million tons of tailings capacity and compared in combinations to determine whether the area of wetland impact could be reduced. This comparison resulted in three combinations (Sites 3A+8A, 3A+11A, and 8A+11A) that could potentially reduce direct wetland impacts. The configuration of the smaller alternative facilities is shown in Figure 2-8, and the three alternatives (site 7, site 9, and combination sites 3A+11A) that were given further consideration are summarized in Table 2-11.

Comparing the remaining eight TSF site alternatives to the proposed Project (shown in Table 2-12 as "TSF Alternative Site 3"), showed that all of these alternatives may reduce direct wetland impacts when compared to the proposed Project ("Direct Wetland Impacts" in Table 2-12). However, only three TSF site alternatives would reduce direct stream impacts or maintain them at the same level as the proposed Project ("Direct Stream Impacts" in Table 2-12). Direct wetland impacts potentially could be reduced from 3 to 39 percent compared to the potential impacts of the proposed Project (TSF alternative Site 3). For direct stream impacts, only TSF alternative Sites 7 and 9 would be able to reduce direct impacts on streams (from 12 to 23 percent), or the direct impacts would remain essentially the same (Sites 3A+11A). All other TSF site alternatives would result in an increase in direct stream impacts. When considering direct wetland and stream impacts together, TSF alternative Sites 7, 9, and the combination of Sites 3A+11A would likely reduce direct impacts on Waters of the U.S. and were found to merit further consideration.

TSF alternative Sites 7, 9, and the combination of Sites 3A+11A were evaluated and compared to TSF alternative Site 3 (the proposed Project) (Table 2-11). Although the alternative sites likely would reduce direct impacts on Waters of the U.S., none would meet the overall Project purpose because they are not practicable. Factors used to consider the practicability of each alternative are shown in Table 2-11.

Although the TSF alternative Sites 7 and 9, and the combination of Sites 3A+11A would reduce direct impacts on Waters of the U.S., none of these would meet the overall Project purpose and none were found to be practicable. The following factors affect practicability for these TSF site alternatives:

- **TSF Site Alternative 7 –** This alternative would require relocation of existing residences, acquisition of three additional parcels, and significantly greater embankment material—and would increase TSF construction costs by more than 100 percent. Reclamation would be more difficult due to drainage issues. The alternative also would require relocation of the Mill Site and other site infrastructure.
- **TSF Site Alternative 9 –** This alternative also would require acquisition of additional land parcels. Construction costs would increase by 16 percent, and the site alternative would require relocation or reconfiguration of two OSAs, which would likely cause additional direct stream and wetland impacts.
- **TSF Site Alternative 3A+11A –** This alternative would affect up to 72 residences; require acquisition of an additional 129 land parcels; require three at-grade highway crossings; and increase transportation distance and costs, with increased diesel emissions. It also would require relocation of a planned OSA to another location, which would likely cause additional direct stream and wetland impacts.

Based on this evaluation, multiple TSF sites are not practicable and are not considered further in the EIS.

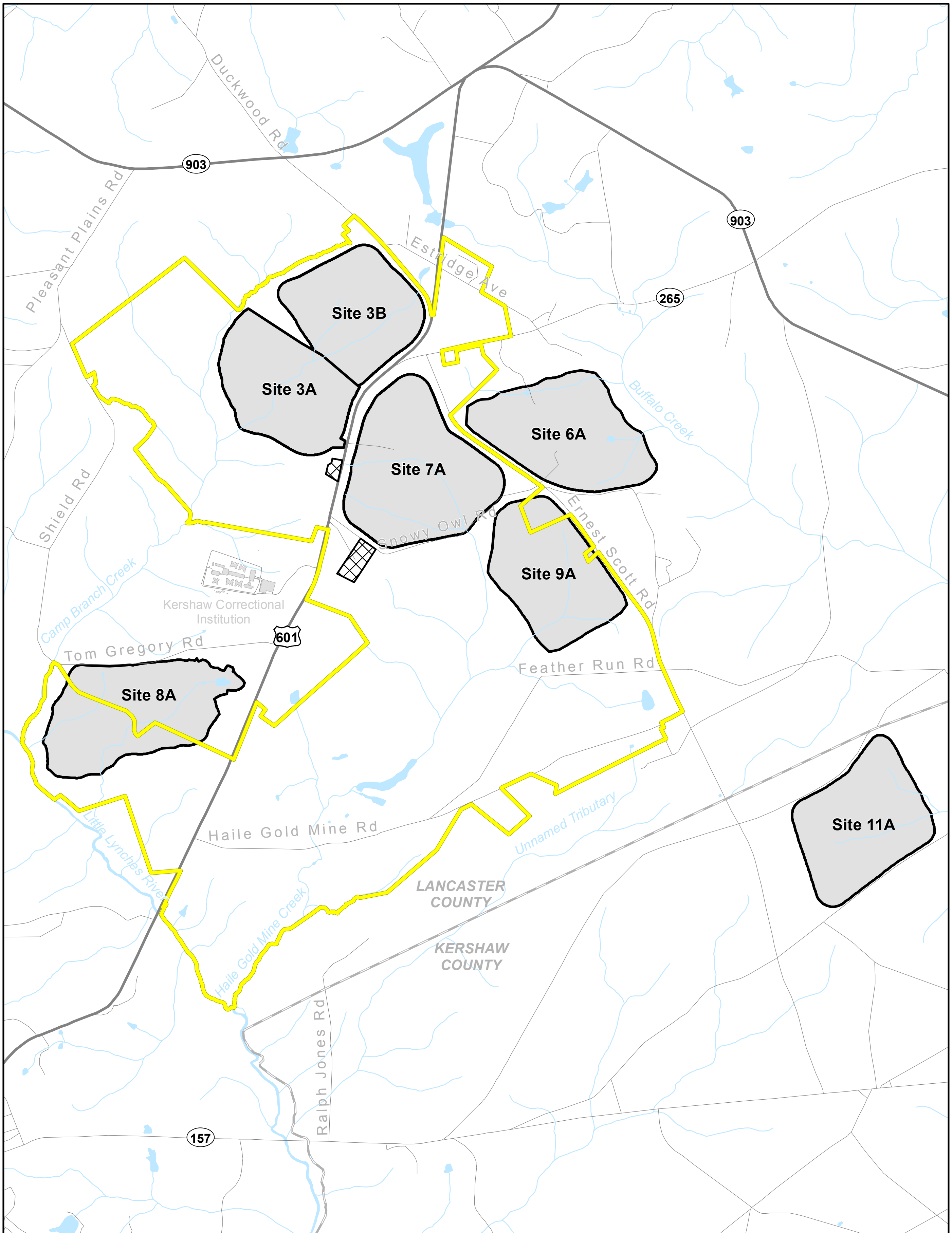

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Figure 2-8

Locations of Tailings Storage Facility Site Alternatives 3A, 3B, 6A, 7A, 8A, 9A, and 11A

0 1,500 3,000 Feet

0 400 800 Meters

Sources: AMEC 2012, ESRI 2008.

Legend

- Project Boundary
- Not Part of Project
- Alternative TSF Sites
- County Boundary

Table 2-11 Detailed Screening Analyses for Three Tailings Storage Facility Site Alternatives Compared to the Proposed Project

Factor	Site 3 (Proposed Project)	Site 7	Site 9	Combination Sites 3A+11A
Storage capacity (million tons)	40	40	40	40
Direct wetland impacts (acres)	59	45	57	33
Direct stream impacts (linear feet)	7,331	6,447	5,671	7,380
Total land disturbance (acres)	479	413	506	784
Current land use	Vacant	Residential and vacant	Residential and vacant	Residential and vacant
Watersheds directly affected	Camp Branch Creek Little Lynches River	Haile Gold Mine Creek Little Lynches River	Haile Gold Mine Creek Little Lynches River	Unnamed drainage Buffalo Creek
Residences affected	0	2	0	72
Distance to Mill Site (miles)	1.1	0.7	0.6	3.3
Embankment volume (cubic yards)	12,570,000	44,920,000	16,910,000	11,370,000
Embankment height (feet)	155	230	130	140
Tailings basin area (acres)	283	182	312	372
Reclaim Pond area (Percent of TSF area)	28%	63%	27%	17%
Surface water needed per year (gallons)	89,000	62,000	104,000	112,000
Construction material availability	All starter facility embankment construction materials available from the basin excavation.	Would require starter embankment construction material from outside borrow source or use of mine overburden.	Would require starter embankment construction material from outside borrow source or use of mine overburden.	All starter facility embankment construction materials available from the basin excavation.
Geotechnical constraints	Foundation conditions known. Sufficient area to develop stable tailings beach.	Foundation conditions unknown. Insufficient area to develop stable tailings beach.	Foundation conditions known. Sufficient area to develop stable tailings beach.	Foundation conditions unknown. Sufficient area to develop stable tailings beach.

Table 2-11 Detailed Screening Analyses for Three Tailings Storage Facility Site Alternatives Compared to the Proposed Project (Continued)

Factor	Site 3 (Proposed Project)	Site 7	Site 9	Combination Sites 3A+11A
Transportation	Requires one highway overpass. Tailings delivery line passes through vacant land.	Requires one at-grade road crossing. Tailings delivery line passes through vacant land.	Requires no road crossings. Tailings delivery line passes through vacant land.	Requires three at-grade road crossings and two highway overpasses. Tailings delivery line along a highway.
Tailings storage facility capital construction cost	$125,000,000	$280,000,000	$145,000,000	$154,000,000
Operating cost per year	$715,000	$1,080,000	$635,000	$1,060,000
Infrastructure cost	$4,600,000	$2,600,000	$2,500,000	$11,000,000
Factor	Site 3 (Proposed Project)	Site 7	Site 9	Combination Sites 3A+11A
Total number of land parcels required	12	33	17	156
Additional land acquisition	0	25.33 acres 3 parcels	60.27 acres 2 parcels	1,392.85 acres 129 parcels
Relocation of mine facilities	None	Relocation of Mill Site/Utility Pond	Relocation or reconfiguration of OSAs	None
Potential mineralization beneath facility	No potential	Unknown	Known potential	Unknown
Closure and reclamation issues/risk	Typical for conventional TSF with one drain.	Closure and reclamation would be difficult and take much longer because the entire basin would be covered by the Reclaim Pool; this would result in an undrained and less consolidated tailing mass.	Typical for conventional TSF; however, facility does cover several drains that would need to be monitored.	Typical for conventional TSF with one drain.

Table 2-11 Detailed Screening Analyses for Three Tailings Storage Facility Site Alternatives Compared to the Proposed Project (Continued)

Factor	Site 3 (Proposed Project)	Site 7	Site 9	Combination Sites 3A+11A
Summary	Comparable impacts to other alternatives. Least expensive alternative. All land presently owned by Applicant. No geotechnical or mineralization issues.	Would cost $155 million more than Site 3. 44 million more cubic yards required for embankment. Technically difficult to construct. Reclaim Pond area too large.	Would cost $20 million more than Site 3. May overlap mineralized zone. Would require moving OSAs.	Would affect 2,541 more linear feet of stream than Site 3. Would cost $35 million more than Site 3. Would affect Buffalo Creek watershed. Additional public safety issues. Requires acquisition of 1,392 acres (129 parcels) and relocation of 72 residences.

OSA = overburden storage area
TSF = tailings storage facility
Source: Haile 2012b.

Storing Tailings at Other Abandoned Mine Sites

Abandoned regional gold mines were considered as alternative sites for disposal of tailings. The Brewer Mine, located approximately 10 miles from the proposed Haile Gold Mine, was considered for development of a TSF. Tailings could be transported through a buried pipeline to the Brewer Mine, where the tailings solids could be disposed of and the water returned to the proposed mine for operational use or treatment and discharge.

A 10-mile pipeline would require purchase of a right-of-way through private land, which would need to be negotiated with individual property owners. The 10-mile pipeline right-of-way would likely affect streams and wetlands that would otherwise be unaffected by operations at the Haile Gold Mine site. There would be increased risk of pipeline failure and subsequent spills of waste into the environment from a pipeline situated outside of the currently proposed Project boundary (e.g., unintentional land disturbance activities such as agriculture or utility work).

Approximately one-quarter of the 1,000 acres at the Brewer Mine has been disturbed by mining operations, which is less than the required approximately 500 acres needed for the TSF; therefore, additional land would be required to construct a TSF. This additional land may include impacts on Waters of the U.S. depending on the site location and design. These impacts cannot be quantified. The previously disturbed areas at the site have been closed and reclaimed, a process that requires no land disturbance; therefore, construction of a TSF would be impractical. In addition, the Brewer Mine site is on the National Priority List for cleanup and as such may not be eligible for use as a waste storage facility.

Use of other abandoned mine sites for storage of tailings is not practicable for the reasons listed above, including impacts on Waters of the U.S. This alternative is not discussed further in the Draft EIS.

Table 2-12 Comparison of Direct Impacts on Waters of the United States from Tailings Storage Facility Alternative Sites

Rank Order of Tailings Storage Facility Alternatives →									
Direct Wetland Impacts									
Tailings storage facility alternative site	3A+11A	8A+11A	8	3A+8A	11	7	6	9	3[a]
Direct wetland impacts (acres)	33	36	39	41	43	45	55	57	59
Percent change compared to Site 3 (proposed Project)	-44	-39	-34	-31	-27	-24	-7	-3	Proposed Project
Direct Stream Impacts									
Tailings storage facility alternative site	9	7	3[a]	3A+11A	6	11	3A+8A	8	8A+11A
Direct stream impacts (linear feet)	5,671	6,447	7,331	7,380	9,201	9,872	15,047	15,735	16,164
Percent change compared to Site 3 (proposed Project)	-23	-12	Proposed Project	+1	+25	+35	+105	+114	+120

Note:

Grey shading indicates a reduction or no significant change in impacts compared to the proposed Project; rose shading indicates an increase in impacts compared to the proposed Project.

[a] TSF alternative Site 3 is the Duckwood TSF that is part of the proposed Project.

Using Tailings to Backfill the Pits

Placing the processed tailings into finished pits as backfill was considered as an alternative to building a TSF or to reducing the size of the TSF. This alternative is not considered feasible for several reasons. The tailings contain higher levels of sulfide minerals and higher levels of potential acid generation. The pits would need to be lined to contain PAG drainage from the tailings slurry, increasing the cost and the risk of groundwater contamination. Because the tailings would be in a belowground pit, they would be much more difficult to manage in the case of groundwater contamination.

Unlike the proposed TSF, tailings slurry placed in the pits would likely retain higher moisture content because they could not be drained, causing the backfilled pit to be unstable after closure. Uneven settling could occur, making long-term stabilization and reclamation infeasible. PAG materials placed in the pit would likely need to be neutralized with considerable alkaline amendments, which would considerably increase the cost.

Placing tailings in the pits as backfill would displace the Yellow Class overburden that would be placed in the pits under the proposed Project. Because Yellow Class overburden has a higher PAG, it would need to be stored in a lined facility like Johnny's PAG. If the PAG materials were separated from the tailings prior to placement in the pits, issues would remain regarding the stability of the reclaimed pits—in addition to the costs and issues associated with separating the PAG materials as described above.

Using tailings to backfill the pits is not practicable and is unlikely to considerably reduce direct impacts on Waters of the U.S. Therefore, this alternative is not considered further in the EIS.

Alternative Tailings Storage Technologies

The USACE also considered dry stack and paste tailings technologies as a means to reduce consumptive water use during tailings disposal. Haile's proposed tailings system design uses a water-based slurry to transport tailings from the Mill to the TSF. At the TSF, the water is decanted or allowed to drain from the wet tailings and is then collected and recycled. Some water is lost to evaporation in this process. The proposed design is water conservative through the practice of re-use.

Using drystack and paste tailings disposal technologies would require additional facilities and equipment to prepare the tailings for disposal by drying it (dry stack) or introducing additives (dry paste) and transporting it to the disposal site. The addition of these facilities would increase the disturbed area within the Project boundary and associated environmental effects (increased emissions from vehicle movements). It also would increase Project capital and operating costs. Use of the dry stack and paste tailings technologies would require creation of a tailings impoundment for ultimate storage of approximately the same amount of material. This technology would require a footprint similar to the proposed TSF; therefore, it is unlikely that impacts on Waters of the U.S. would be reduced. Because the use of dry stack and paste tailings technologies would increase the amount of disturbed area, not offer environmental benefits except a potential reduction in water use, and increase Project capital and operating costs, the alternative was considered not practicable. This alternative is not discussed further in the Draft EIS.

2.5.2.8 Water Management Alternatives

Gold ore processing, transport of tailings to the TSF, dust control in the Project area, and other mine operations require an available water supply. Of these needs, ore processing and transport of tailings slurry require the most water. The Applicant has configured the ore processing water within a closed-loop system supply that would recycle all available TSF reclaim water first, with supplementary make-up water needs coming from contact water and pit depressurization water. The amount of make-up water needed depends on seasonal and annual hydrologic conditions (dry, average, or wet years) and, in particular, the amount of rainfall that falls on the TSF. Under the combined circumstance of drought and minimal water recovered from the TSF, the need for make-up water would be greatest. Separately from process water, stormwater would be collected from OSAs, borrow areas, roadways, the Mill facilities, and other disturbed sites. This stormwater would be released to surface waters after detention to manage flow and water quality.

The mine's water supply plan must be based on balancing the water requirements of the processes within the mine, seasonal and climatic variations in rainfall and runoff, water resources within the site (streams, lakes, and groundwater), water storage requirements, water discharges, and the additional water that must be added to the system.

The Applicant's site-wide water supply plan was designed to address a number of objectives and issues, including the following:

- Providing sufficient water for process operations;
- Maximizing the internal use and re-use of water within the Mill to avoid the need for make-up water requirements;
- Re-using and reclaiming water within the Mill;

- Maximizing re-use of TSF tailings slurry water;
- Managing the Mill and TSF process water, contact water, and non-contact water as separate systems to avoid contamination with sediment, contaminants, and chemicals;
- Minimizing discharges to surface waters;
- Limiting the use of municipal water to drinking water use unless otherwise needed for operations;
- Reducing groundwater levels around mine pits through depressurization;
- Ensuring that stormwater and contact water meet appropriate standards prior to release;
- Providing storage for probable maximum flood events in the TSF and high rainfall events for all facilities;
- Avoiding the need for on-stream impoundments for storage of water supplies; and
- Maintaining baseflows in streams for aquatic resources.

As previously described, the site-wide water management three-part plan proposed for the Haile Gold Mine includes:

- A closed-loop process water cycle for the Mill and TSF;
- A contact water management plan and water treatment plant for all excess contact water (Johnny's PAG, pit water, and low grade ore stockpile runoff and seepage); and
- A non-contact water management plan to manage runoff and stormwater that has not come into contact with potential contaminants.

A discharge permitting plan would address state and federal water quality standards for all discharges. In addition, the Applicant has developed a site-wide water balance model using GoldSim (ERC 2012). This model simulates water quantities and rates used in the mining process over the life cycle of the mine, together with a full range of variable rainfall and climate conditions. The Applicant has created and optimized the site-wide water management plan to achieve these multiple objectives (ERC 2012).

As noted, the Applicant's largest water supply requirement is water for ore processing at the Mill. As described in Section 2.5.2.4, there are no practicable alternatives to the method used for ore processing that would not result in other environmental impacts. The Applicant has maximized the re-use of tailings slurry water so that make-up water requirements under average and wet hydrologic conditions would be only 16 percent of total process needs. Under dry hydrologic conditions, make-up water requirements would rise to between 16 and 66 percent of total process needs. Make-up water would primarily come from pit depressurization and contact water, and is expected to be available during most hydrologic conditions.

Based on the information above, the basic needs and constraints of the water management system of the proposed Project as determined in the alternatives analysis largely define the primary elements of the design of the system, and no wholesale new alternatives to the proposed water management system are practicable. Therefore, this alternative is not discussed further in the EIS.

2.5.2.9 Haul Road Alternatives

In the proposed Project, haul roads are designed with a minimum 95-foot operating width, including safety berms and drainage. The total footprint for combined haul roads would be 128 acres, with estimated direct impacts on wetlands of 5.8 acres and impacts on streams of 1,617 linear feet, not including areas within the pit-related activities portion of the mine (ERC 2013; Haile 2013b). The haul road with the greatest impact on Waters of the U. S. is the TSF haul road, which would affect 2.2 acres of wetlands and 615 linear feet of stream.

Alternatives to reduce direct impacts associated with haul roads are limited because the haul roads (1) are configured based on the locations of other major mine components, such as the Mill Site, the OSAs, the pits, and the TSF; and (2) were already realigned once in the August 2012 revised mine plan to avoid and minimize impacts. Further refinement of existing alignments may reduce impacts slightly. For example, the TSF haul road could be realigned to exit the Mill Site perpendicular to the riparian area, thus reducing direct impacts at that location. Because of the extent of indirect impacts on wetlands across the Project area (see Section 4.6), realignment of haul roads would not reduce overall impacts on Waters of the U.S.

The USACE also considered elimination of the haul road between the Mill and the TSF and sole reliance on a buried slurry pipeline. The proposed Project includes a buried pipeline to transport tailings slurry to the TSF. Because a portion of the TSF would be constructed from overburden material, a haul road is required to move overburden material from the pit locations to the TSF. The haul road also is required to provide access to the TSF for operations, maintenance, and inspection.

For the reasons described above, haul road alternatives are not discussed further in the Draft EIS.

2.5.2.10 Alternative Transmission Line Routes

The proposed Project would require an interconnecting distribution transmission line to the electrical grid. As described in Section 2.3, construction of the interconnecting transmission line would be undertaken jointly by Duke Energy and Lynches River Electric Utility as a separate action and not a part of the proposed Project. Four separate routes for transmission interconnection between the mine's main substation and the point of interconnection with Duke Energy's transmission grid were discussed with the utilities. Haile discussed with Central Electric alternative transmission line alignments between Haile's substation and the interconnection point, and reviewed four alternative routes with Central Electric. Central Electric determined that the route shown in Figure 2-2 represents the least amount of impact and the least-cost route, primarily because it parallels existing infrastructure (Haile 2012a). No other transmission line alignments are evaluated as alternatives in the Draft EIS.

2.5.2.11 Alternative Mine Operation Sequences

The Applicant's proposed sequence of mining operations is based on many interrelated engineering, financial, logistical, and practical requirements and constraints. The planned order for mining the pits reflects the realities of the site, the location and depth of the ore, gold prices, and the financial plan for creating revenue early in the Project life to fund the large cost of overburden removal before gold is being produced, as well as to provide yield to investors.

The Applicant's proposed operations sequence is based on first extracting the lowest cost metal; extracting the higher cost metals toward the middle of the mine life to increase the economic feasibility of the Project; and late in the Project, processing the lower quality ore that has been stockpiled (Haile 2012f). This would be accomplished by first mining the ore with the least overburden. The proposed sequence accomplishes a number of objectives in that the ore body is reached quickly, and gold processing and production can begin early in the mine sequence. The proposed mining sequence also reduces the overburden storage requirements. Once the early pits are mined, they can be used to store overburden from the subsequently mined deeper pits.

Alternatives to this mining sequence may result in changes in the planned timing of financial returns and possibly changes in the total financial return. In addition, changes in the proposed mining sequence would not likely improve the environmental performance of the mine and could increase overburden storage requirements, which could result in increased direct impacts on Waters of the U.S. Consequently, although alternative mining operation sequences were considered, none were found that were practicable or with the potential to reduce impacts. Therefore, this alternative is not considered further in the Draft EIS.

2.5.2.12 Alternative Project Configurations

Many elements were considered in developing the mine plan for the proposed Project, including physical factors and limitations such as the location of the economically recoverable gold, the concentration of the gold, the type of rock the gold is located in, the strength of the layers of rock, the minerals and chemical makeup of the rock, the permeability of the rock to groundwater flow, and the locations of streams and wetlands in the Project area. Variations in these factors can significantly affect the design and footprint of the mine operations. For example, the strength and permeability of the rock determines how steep the pit walls can be safely maintained, which in turn determines how big the pit needs to be to reach the gold-bearing ore, and how much overburden needs to be mined and stored.

Any gold mine plans that would meet the overall Project purpose would involve large-scale operations with multiple interacting components, as described in the proposed Project (Appendix A). The development of a mine plan involves the optimization of many variables. Some of the variables in developing a mine plan are selected, such as projected gold prices, technology used to extract the gold from the ore (determines the efficiency of recovery), mining equipment (determines the rates and costs of extraction), and to a limited extent, the layout of the mine. Other variables are fixed by virtue of existing conditions at a site, such as the composition of the rock, location of the ore body, water chemistry and flow rates, and location of waters and resources at the mine site.

Other considerations in developing a mine plan include ore processing methods, the overall size of the Project, the production rates and schedule, regulatory constraints, safety, and infrastructure. These variables are closely interrelated to other mine elements. For example, selection of a processing method affects the efficiency of gold extraction, the chemicals needed to process the ore, and to a certain extent, the volume and composition of the tailings. Regulations and technical constraints affect the configuration of haul roads, pit and OSA slopes, the TSF embankment, and water management.

The proposed Project is an alternative that represents the Applicant's optimized design to address the many engineering, geologic, ore body location, logistical, financial, safety, and other considerations. A primary design criterion for the proposed Project has been avoidance and minimization of direct impacts on Waters of the U.S. The mine design process by the Applicant has been iterative, and changes were made by the Applicant when additional land ownership was accomplished (Haile 2012b). Changes in the Project design were made to further reduce the direct impacts on streams and wetlands for those components of the mine that were capable of being altered and remain practicable.

As shown in Figure 2-1, direct impacts on Waters of the U.S. have been minimized for those elements of the Project that are more flexible in their design and location—the OSAs, growth media storage areas, the Mill Site, borrow areas, and the utility ponds. Most of the remaining direct impacts on Waters of the U.S. result from the pit locations (which are constrained by the location of the ore body and engineering and safety factors) and the Duckwood TSF.

The Feasibility Study conducted by the Applicant (M3 Engineering & Technology Corporation 2010) is an industry-standard review of the feasibility and economic viability of the mine plan at various gold prices, and was the primary basis for the proposed Project. An aspect of the mine plan most closely evaluated by the Applicant was estimating how much gold can be recovered and ultimately the financial feasibility of the Project (M3 Engineering & Technology Corporation 2010). Adjusting the financial assumptions could result in different pit configurations but would involve changing financial risk levels or revenue projections. The Applicant performed a sensitivity analysis on financial variables to determine which were most important to the mine plan; the analysis indicated that gold price and gold grade were the most important variables (M3 Engineering & Technology Corporation 2010).

The current configuration is based on an estimated market price of $950 per ounce of gold. The projected price of gold determines what grade of ore can be profitably mined and processed, which in turn determines the size and configuration of the pits at the site. At higher gold prices, larger and deeper pits may be cost effective as gold would command a higher price and because lower grade ore would be mined and processed. Even with higher or lower assumed gold prices, the pits would be located in approximately the same location and configuration.

Alternative mine plans based on higher market prices were not considered feasible because of the greater direct impacts on Waters of the U.S. from the increased pit sizes, increased OSA storage requirements, and increased tailings storage requirements. Additional considerations regarding feasibility were limitations on property ownership and increased financial risk if gold prices do not meet the higher gold price targets. Alternative mine plans based on lower gold prices have lower returns and become financially infeasible.

In summary, a wide range of alternative configurations for the mine elements and their locations was considered during the alternatives analysis, with a primary design criterion of avoidance and minimization of direct impacts on Waters of the U.S. The proposed Project is a relatively compact mine configuration in which the flexible elements of the mine have been designed and located to largely avoid direct impacts on Waters of the U.S. to the maximum extent practicable. The remaining direct impacts on Waters of the U.S. are located in areas for which practicable alternatives with fewer direct impacts could not be achieved. Therefore, alternative Project configurations are not considered further in the Draft EIS.

2.5.3 Summary of Alternatives Eliminated from Further Consideration

Based on the analysis of alternatives submitted by the Applicant, the USACE's review of those analyses, and the USACE's independent analysis of alternatives, a number of alternatives for various components of the proposed Project were identified, examined, and determined not to be reasonable or practicable alternatives for detailed evaluation in the EIS. These alternatives are summarized in Table 2-13.

Table 2-13 Summary Evaluation of Alternatives

Alternative	Findings	Conclusion
Alternative mine locations	The presence of gold ore reserves and gold ore resources has been established in the Carolina Slate Belt through exploration by a number of companies and agencies, including the Applicant. Gold mining must be located where gold ore reserves have been established. Establishing ore reserves requires a formal feasibility analysis prepared according to industry standards. No other gold reserves have been established in the Carolina Slate Belt region, and directing the Applicant to explore and establish reserves elsewhere is not reasonable or practicable.	Mining at a different location in the Carolina Slate Belt would not meet the overall Project purpose because reserves have not been established at a different location. This alternative does not meet the overall Project purpose and is not practicable.
Alternative mining methods	Two general methods of ore extraction are used for gold mining—open-pit mining and underground mining. Underground mining can be achieved with less surface disturbance and could reduce potential impacts on wetlands and other Waters of the U.S. Underground mining methods typically are used where the concentration of gold in the mineral-bearing ore is higher, and smaller volumes of ore can be extracted with underground mining methods to yield financially feasible quantities of gold. The gold ore concentrations at the Haile Gold Mine are well below the values generally accepted in the industry as being economical for underground mining methods. The open-pit method would be able to cost-effectively extract the reserves identified at the Haile Gold Mine, whereas underground mining would not be able to achieve the same full recovery of the established gold reserves. The location, depth, boundaries, and quality of the gold ore reserves are paramount in determining the optimal pit design—defined as the contour that is the result of optimizing the amount and quality of ore extracted for the volume of overburden while satisfying operational requirements and safe wall slopes. Together with other factors, the optimal pit design also maximizes profit for the established reserve. Given the ore reserves defined at the Haile Gold Mine, the pit optimization process largely minimizes the surface area disturbance needed to mine the ore reserve because moving any more than the minimum amount of overburden is financially disadvantageous. Alternative conceptual pit designs were considered to determine whether the ultimate footprint of the pits could be altered to reduce direct impacts on wetlands and other Waters of the U.S.	Alternative mining methods at the Haile Gold Mine would not meet the overall Project purpose and are not practicable for financial and technical reasons widely accepted in the gold mining industry. Larger pits would increase overburden storage requirements and would increase direct impacts on Waters of the U.S. Smaller pits could reduce some direct impacts on wetlands and other Waters of the U.S.; however, smaller pits with similar volume would reduce the recovery of gold reserves and would not meet the overall Project purpose. Smaller pits with steeper slopes designed to recover all of the recoverable reserves are not practicable because of unlikely and unknown technical feasibility (the safety of side walls and equipment constraints).

Table 2-13 Summary Evaluation of Alternatives (Continued)

Alternative	Findings	Conclusion
Alternative ore processing methods	Alternative ore processing methods were evaluated, including the tank processing method proposed by the Applicant, heap leaching, pressure oxidation, and concentrate roasting. Heap leaching was found to be less efficient at extracting gold, to increase direct impacts on Waters of the U.S because of greater land requirements, and to increase the risk of environmental exposure to cyanide. In addition, heap leaching is not suited to the humid climate. An alternative was examined in which the tailings stream would be differentiated and sulfur-bearing minerals segregated for storage in a separate TSF. The purpose of this alternative would be to reduce the overall sulfur-bearing content of the tailings and their potential for generating acid mine drainage. However, segregating the tailings would require partitioning the TSF or building a second TSF for the higher sulfur content tailings. Separating the tailings also would allow higher sulfur tailings to potentially be sold as a commercial product. Pressure oxidation would result in higher gold and silver recovery and neutralized sulfide minerals but would require building a processing facility and would increase net annual operating costs. The proposed TSF may need to be enlarged, causing an increase in the disturbed area footprint for the TSF. Concentrate roasting has been used infrequently in the U.S. and elsewhere. Gas emissions from the process would require treatment prior to release. The treatment equipment would substantially increase capital and operational costs, and the process would produce substantial quantities of sulfuric acid. Impacts on Waters of the U.S. could be similar to those of the proposed Project, depending on space requirements for the TSF.	Heap leaching would meet the overall Project purpose and is less expensive; the alternative is not environmentally preferable to the proposed tank processing method because greater land requirements would increase direct impacts on Waters of the U.S. Separation of the tailings stream would not meet the overall Project purpose. The alternative was found not to be practicable because there is no identified market for the high-sulfur content material, construction and operation of a partitioned TSF or construction of a separate TSF would increase Project costs, and potential enlargement of the TSF would likely increase direct impacts on Waters of the U.S. Pressure oxidation processing is not practicable because of increased costs; enlargement of the TSF would increase the disturbed area footprint and associated direct impacts. Concentrate roasting is not practicable because of increased costs, the technology is not proven, and it is not environmentally preferable to the proposed Project.
Alternative Mill Sites	The Mill Site, including the chemical storage area, water treatment plant, equipment maintenance shop, fueling station, and main offices, were co-located to increase operational efficiency and reduce the Project footprint. The central location close to the mine pits reduces traffic and safety risks related to hauling ore. The revised DA permit application (2012) included reconfiguration of the Mill Site, which eliminated direct impacts on Waters of the U.S. from this facility.	No alternative reconfiguration or relocation of the Mill Site was identified that could reduce direct impacts on Waters of the U.S.

Table 2-13 Summary Evaluation of Alternatives (Continued)

Alternative	Findings	Conclusion
Alternative overburden storage areas	A portion of the overburden material removed prior to and during the mining process would be permanently stored adjacent to the pits in large mounds. Three of the seven planned OSAs require filling of wetlands and streams. Reconfiguration or relocation of the OSAs was considered to reduce direct impacts on wetlands and streams. Relocating an OSA to undisturbed locations within the Project area was found not to reduce direct impacts; however, re-use of the Holly and Hock TSF borrow areas as a potential OSA was evaluated. Use of this location as an OSA would allow a reduction in the size of the Ramona OSA, which would reduce total direct impacts on wetlands by approximately 1.8% and total direct impacts on streams by approximately 26.8%.	Use of the Holly and Hock TSF borrow areas for overburden storage may be practicable, may meet the overall Project purpose, and would reduce direct impacts on Waters of the U.S.
Alternative tailings storage and management	Twenty-one different locations of single 15- to 40-million-ton capacity or multiple 20-million-ton capacity TSF facilities were evaluated, in addition to placing processed tailings into finished pits as backfill as an alternative to building a TSF or reducing its size. A series of environmental impact and technical criteria were considered for each, and the results were evaluated in detail.	While certain alternative TSF sites may meet the overall Project purpose (TSF alternative Sites 7, 9, and 3A+11A) and would reduce direct impacts on Waters of the U.S., none of the alternative sites were considered practicable.
Water management alternatives	Management of water supply and contact water systems has been optimized by the Applicant based on the proposed ore processing system that includes significant water conservation measures. No alternative water management system was identified that would reduce the use of available water resources.	No alternatives were identified. Potential minimization or avoidance measures will be considered during the evaluation of impacts in the EIS.
Haul road alternatives	All roads within the Project area are directly associated with the location of specific facilities except the haul road between the Mill Site and the TSF. Any alternative routes for this road would increase its length and associated impacts.	No alternatives were identified. Potential minimization or avoidance measures will be considered during the evaluation of impacts in the EIS.
Transmission line route alternatives	A 69 kilovolt transmission interconnection would be constructed as a separate project by an electric utility. The suggested route would parallel an existing transmission line and highway. This is considered a connected action under NEPA.	No alternatives were identified, but the transmission line will be considered in the EIS environmental analysis as a connected action.
Alternative mine operation sequences	The Applicant’s proposed sequence of mining operations is based on the location and grade of ore and the physical configuration of the ore body, in addition to other interrelated engineering, financial, logistical, and practical requirements and constraints. No alternative mine operation sequence was identified that would reduce impacts on Waters of the U.S.	No alternatives were identified.
Alternative Project configurations	A wide range of alternative configurations for the mine elements and their locations was considered during the alternatives analysis, with a primary design criterion of avoidance and minimization of direct impacts on Waters of the U.S. No alternate configuration was identified that would meet the overall Project purpose and reduce impacts on Waters of the U.S.	No alternatives were identified.

2.6 Alternatives Recommended for Further Analysis in the EIS

Based on information submitted by the Applicant as part of the application for a DA permit, and its own independent review, the USACE has completed the identification and evaluation of alternatives for the proposed Haile Gold Mine Project. The USACE has identified the following three alternatives for further analysis in the EIS:

- **Applicant's Proposed Project –** The Haile Gold Mine Project as proposed by the Applicant in the revised DA permit application dated August 15, 2012.
- **No Action Alternative –** The application for a DA permit would be denied; the proposed Project would not occur; the Applicant would continue to complete post-closure monitoring of the Haile Gold Mine site consistent with the previous South Carolina mine permit conditions; future suitable uses of the Project lands may occur.
- **Modified Project Alternative –** A variation of the proposed Project with the Holly and Hock TSF borrow areas used as OSAs and commensurate reduction in the size of the Ramona OSA; other adjustments to the Project to avoid and minimize impacts.

The potential impacts of these alternatives are presented in Chapter 4 "Environmental Consequences."

2.7 Description of the No Action Alternative

Under the No Action Alternative, the USACE would not issue a DA permit and none of the proposed mine construction, operations, reclamation, or committed compensatory mitigation (compensatory wetland and stream mitigation) activities would occur. Under this alternative scenario, the Applicant would not mine gold in the Project area, and the consequences of the continued current use or other likely uses of the Project site are considered.

The Project area currently owned by the Applicant consists of 4,552 acres within the Project boundary. The Project area includes areas affected by past mining activities (where mining activities under the proposed Project would be focused), and land purchased by the Applicant to support mining activities, such as storage of overburden, tailings storage, and the Mill Site.

The property is currently disturbed (with reclaimed/revegetated mine features) and is wooded with both natural and logged pine and hardwood forests. Previous gold mining activities at the site ended in 1992; mining for Mineralite® continued until 2010 (Haile 2012g). Post-closure monitoring activities associated with closure and reclamation of the previously mined areas are ongoing. The reclamation activities have occurred and continue under plans submitted to and approved by the SCDHEC for Permit #601 issued in 1984 and in conjunction with NPDES Permit SC0040479 issued in 1988 (Haile 2012g). When the Applicant purchased the existing mine facilities in 2007, the Applicant assumed responsibility for continuation and completion of approved reclamation plans. Permit plans and conditions have been modified and updated since they were issued in response to changing conditions and treatment methods.

Table 2-14 shows the current status of closed facilities at the site, including the year in which the facility was closed and the type and status of reclamation that took place. This table shows that closure has been completed on all but two of the previously active facilities. The proposed Project includes approximately 176 acres that were closed prior to 2010. The locations of the former mining facilities, which are primarily located in the southern portion of the proposed Project area, are shown in Figure 1-4.

Table 2-14 Past Mining Features, Facilities, and Reclamation Status

Closed Facility	Acreage	Year Closed	Reclamation Type
Historic East Red Hill Dump	1.1	1988	Capped, graded, and revegetated
Historic West Red Hill Dump	5.5	1989	Removed and used to fill Red Hill Pit
East 601 Pit	1.5	1989	Revegetated – reclamation complete
West Champion Pit (C-91)	1.7	1991	Pit lake – reclamation complete
W601 Pit and Access Road	8	1992	Revegetated – reclamation complete
Champion Pit	4	2000	Pit lake
Champion Rock Dump	5.5	2000	Removed – reclamation complete
South Pad and #3 Pond Closure	13	2000	Capped facility and pond removed
Gault Pit	3.5	2001	Pit lake
Lo Preg Pond	1.5	2002	Capped facility
Snake Pit	5	2003	Pit lake
Snake Rock Dump	8.8	2003	Capped facility
Snake Access Road	2.1	2003	Removed
Chase Hill Leach Pad	14.5	2004	Capped facility
Chase Hill Pit	8.4	2004	Capped facility
Haile Pit	8.3	2004	Backfilled pit
188 Rock Dump	13.2	2004	Capped facility
Historic Blauvelt/Bequelin Pits	3.5	2004	Still present – historic (pre-law)
Historic Ledbetter Rock Dump	0.5	2005	Covered with soil and seeded
Red Hill Pit	12.3	2005	Backfilled pit
Borrow areas	11.9	2004–2005	Graded and seeded
Parker Sand Pit	29.4	2010	Graded and seeded
Hilltop I and II Pits	31.5	2010	Interim reclamation complete – pit filled, graded, and seeded

Sources: Schlumberger Water Services 2010; Haile 2012b.

In coordination with the SCDHEC, post-closure monitoring occurred frequently (Haile 2012g). Currently, sampling occurs annually in the spring for most facilities. The exception is Champion Pit, which is still sampled monthly due to a need for periodic acidity reduction adjustments (Haile 2012g). Unit-specific extended post-closure monitoring for closed facilities (except those completely removed) are considered complete after 10 years.

In preparation for developing the proposed Project, the Applicant started a baseline water quality monitoring program in mid-2008. Under this program, monthly, quarterly, and annual monitoring occurs throughout the property—including several locations along Haile Gold Mine Creek (Haile 2012g).

Under the No Action Alternative (if a DA permit was not issued and mining activity at the Project did not occur), it was assumed that the land owned by the Applicant would continue to be managed in a similar manner as it is now, except that current exploratory bore-hole drilling to further define the extent of mineral reserves would cease. Haile would not continue their baseline water quality monitoring program and would monitor pursuant to previous permits.

The current Lancaster County zoning ordinance designates Haile-owned property within the Project boundary as “Mining District,” the only land use permitted on the site under this current zoning would be mining (Lancaster County 2013a). Other uses of the site would be allowed by Lancaster County only if the site is rezoned to a classification that permits such uses. In the cumulative impacts analysis, major development proposals in the region were reviewed and none were identified in the immediate vicinity of the Haile Gold Mine site.

Potential future uses of the proposed Project site under the No Action Alternative are speculative and may include the following:

- Limited development – The site is in a rural location with no major interstate access. The potential for substantial urban, commercial, or industrial uses is unknown. The site has been used in the past for agricultural activity, primarily grazing and silviculture. However, it has no unique characteristics for this use.
- Future recreational use – The site currently has no developed use and is visited by workers conducting monitoring activities. With its minimal use and the presence of bird and game habitat, it could be used for hunting and fishing recreational use. The site also could be used as park or green space. This use would not require development of facilities or modification of the site but would require rezoning.
- Future mining – The gold and silver reserves that have been delineated by the Applicant and previous owners represent a financially important resource. The site’s previous mining history and the presence of economically recoverable gold and silver reserves make it a potentially viable site for future mining activity. Future mining would require additional exploration to further delineate the mineral resources and development of facilities similar to, and on a scale commensurate with, those proposed by the Applicant. Development of a future mine would require acquisition of permits and approvals, including similar environmental review.

It is also reasonable to expect that the Applicant would sell some or all of the property in the future under the No Action Alternative. In the absence of other significant changes or developments in the area, it is expected that similar land management to what has occurred in the recent past would continue to occur under any ownership, although the specific configuration of any such use cannot be predicted.

In summary, under the No Action Alternative, the following would be expected:

- No disturbance of the site would occur for mining-related activities;
- Reclamation of past mining disturbance and monitoring of recovery efforts would be completed as required under previous permits;
- Wetlands and streams in the Project area would remain in their current conditions subject to natural geomorphologic processes;
- The proposed compensatory mitigation associated with the proposed Project would not occur;
- Economic effects from the proposed mining Project, including direct and induced employment and employment-related income and tax revenues, would not be generated;
- Existing employment would be reduced to monitoring and maintenance staff; and

- Demand for increased local services, including utilities, emergency services, housing, education, medical, and other services to support increased local population derived from increased direct and indirect employment would not be generated.

2.8 Summary of Potential Impacts by Alternative

The current condition of environmental resources potentially affected by the Applicant's Proposed Project and the associated environmental consequences of mining and reclamation activities on these resources are described in Chapters 3 and 4, respectively. The results of the impact analyses for the No Action Alternative, Applicant's Proposed Project, and Modified Project Alternative are summarized in Table 2-15.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Geology and Soils			
Topography	No future removal of soils, overburden rock, or mineral-bearing ore would occur; and no new topographic features would be created.	Proposed Project would include permanent extraction and temporary or permanent relocation of approximately 241 million tons of overburden and 34 million tons of ore rock; considerable permanent modification of the existing topography would occur.	Effects on topography would be similar to the Applicant's Proposed Project with two exceptions—a reduction in the amount of overburden stored at the Ramona OSA and an increase in the amount of overburden stored at the Holly and Hock TSF borrow areas.
Seismic events	Potential for impacts of seismic events on past mining facilities would be minor as most would be reclaimed, removed, or closed.	Increased potential for direct impacts on Project facilities from naturally occurring seismic events, but facilities (e.g., TSF dam and Johnny's PAG) would be designed and constructed to appropriate seismic standards and would be approved by the SCDHEC.	Effects of seismic events on facilities would be the same as the Applicant's Proposed Project.
Soils and surface material	Little change in geologic and soils resources would occur.	Proposed Project activities would require disturbance of soil and surface material over approximately 2,612 acres. Surface disturbance would include loss of soils and surface material from removal and relocation.	Loss of soils and surface material would be the same as the Applicant's Proposed Project except that less surface soil would be disturbed at the Ramona OSA.
Erosion	Areas previously affected by mining activities would experience a reduction in soil erosion from improved vegetative stabilization resulting from the existing mine reclamation program.	Temporary soil erosion may occur from loss of vegetation where Project facilities are located and from creation of the Duckwood TSF and seven OSAs. This impact would likely be reduced post-mining as disturbed areas are reclaimed.	Erosion potential would be the same as the Applicant's Proposed Project except for a slight increase in erosion at the Holly and Hock TSF borrow areas as a result of using these sites for an OSA and a slight decrease in soil erosion at the Ramona OSA due to reconfiguration.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Geology and Soils (Continued)			
Soil type and cover	Little change in soil and cover resources would occur.	Permanent loss or alteration of soil type, cover, and soil chemistry would occur in disturbed areas.	Effects on soil type and cover would be the same as the Applicant's Proposed Project.
Groundwater Hydrology and Water Quality			
Groundwater elevations	Groundwater elevations would likely remain the same as the existing condition.	During active mining, groundwater elevations would be lowered to various degrees extending outward from the mine pits 3 miles to the north, 2 miles to the south and east, and 1.5 miles to the west. The greatest lowering would be nearest the mine pits (lowered approximately 200–800 feet below existing groundwater levels), although the amount of groundwater lowering would be considerably less away from the pits and near the Project boundary. Groundwater lowering would be as much as 25–50 feet in some areas immediately adjacent to the Project boundary. During the post-mining period, most groundwater levels are expected to recover to near pre-mining elevations, except in the immediate vicinity of the pits where groundwater levels would permanently remain 20 to 50 feet below existing levels and generally over the southern half of the Project boundary where groundwater levels would remain 1 to 20 feet below existing levels.	Changes in groundwater levels would be the same as the Applicant's Proposed Project.
Water quality in pit lakes, backfilled pits, and groundwater quality	Current groundwater quality conditions and trends in the study area would continue, with some minor past impacts from mining evident (lowered pH, elevated dissolved solids, and iron in several areas). The water quality of the deep bedrock aquifer would be unlikely to change from native conditions for the aquifer.	During pit refilling, concentrations of sulfide, iron, and dissolved solids would likely be elevated in backfilled pits. The three pit lakes could have low pH (acidic conditions) and associated elevated concentrations of sulfate, iron, and aluminum, similar to the water quality of historical pit lakes. Haile would neutralize the pit lakes by adding lime to raise pH and limit the dissolution of metals.	Effects on water quality in groundwater would be the same as the Applicant's Proposed Project.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Groundwater Hydrology and Water Quality (Continued)			
Water quality in pit lakes, backfilled pits, and groundwater quality (Continued)		Because of groundwater pumping and changed groundwater elevations during active mining, some groundwater constituents could exceed primary and secondary drinking water standards. When including dilution effects, groundwater standards would be met in most cases. Groundwater in the Project area is not used for human consumption. Impacts would be minor.	
Potential impacts from the TSF and Johnny's PAG on groundwater hydrology and water quality	The TSF and Johnny's PAG would not be constructed; therefore, these facilities would not affect groundwater hydrology or water quality.	The presence of these lined facilities would reduce infiltration of precipitation and the associated recharge of groundwater. However, this effect would be small and localized relative to impacts on groundwater levels due to pit depressurization. Liners and seepage collection at the TSF and Johnny's PAG would minimize the potential for infiltration of leachates to groundwater; therefore, the potential impacts on groundwater quality would be minor unless a leak or accident occurred.	Potential impacts on groundwater would be the same as the Applicant's Proposed Project.
Surface Water Hydrology and Water Quality			
Watershed alteration	Conditions in subwatersheds within the Project boundary previously affected by mining activities would slowly improve following reclamation and mine closure as improved vegetative stabilization, reduced erosion and sedimentation, and development of riparian and streamside cover and trees occur. Subwatersheds in the study area not affected by previous mining activity would remain largely unchanged subject to any future watershed development that may occur.	During the active mining period, a total of 1,584 acres would be disturbed, and 927 acres would be intercepted and isolated from the stream system. A total of 31,258 feet of streams would be lost or diverted. During the post-mining period, impacts from watershed alteration would be major for Camp Branch Creek, Haile Gold Mine Creek, the unnamed tributary near the southern side of Champion Pit, and the three unnamed tributaries directly affected by the Ramona OSA. Watershed alteration impacts would be moderate for the unnamed tributary near the western side of Champion Pit and low for the other subwatersheds in the study area. These changes would be temporary, although they would last for years. After reclamation, the impacts of watershed alteration would be reduced over time.	Impacts from watershed alteration would be similar to the Applicant's Proposed Project except that the three unnamed tributaries filled by the proposed Ramona OSA would not be filled and would remain as streams.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Surface Water Hydrology and Water Quality (Continued)			
Streamflow regime	Flows in streams within the Project boundary previously affected by mining activities may improve slightly, but slowly, over time following reclamation as land cover and vegetation revert to a more natural condition. Subwatersheds in the study area not affected by previous mining activity would remain largely unchanged subject to any future watershed development that may occur.	Effects of active mining would include reductions in baseflows, changes in runoff flows, mine releases, and changes in total streamflow regime. Average annual baseflows would be reduced in a number of streams, with considerable baseflow reductions in Haile Gold Mine Creek and its tributaries nearest to the mine pits, and less substantial declines in adjacent subwatersheds. Average annual runoff flows within areas directly disturbed by mining would range from a decrease of 19% to an increase of 12%, depending on the subwatershed. Mine releases of pit depressurization water and effluent from the contact water treatment plant would increase flows in lower Haile Gold Mine Creek during some periods. Changes to total annual flows would range from a decrease of 45% in Haile Gold Mine Creek and its tributaries to an increase of 63% in lower Haile Gold Mine Creek. The average annual flow in the Little Lynches River downstream of the mined area would increase in some years by 3.3% from existing conditions. Impacts would be major for Haile Gold Mine Creek and all of the unnamed tributaries draining to the Little Lynches River, moderate for Camp Branch Creek and the Little Lynches River downstream of Haile Gold Mine Creek, and minor for Buffalo Creek and the Little Lynches River between Camp Branch Creek and Haile Gold Mine Creek. After active mining, baseflows would likely return to levels similar to existing conditions when groundwater pumping to dewater the mine pits ceases and groundwater elevations approach pre-mining levels. This process would take many years—decades in some locations. Streamflow regimes may never fully recover in some streams in the Haile Gold Mine subwatersheds.	Changes in streamflow regime would be the same as the Applicant's Proposed Project except that the three unnamed tributaries filled by the proposed Ramona OSA would not be filled and would remain as streams. Baseflows in these three segments would be lower than under the No Action Alternative. Modification of the configuration of the Ramona OSA could alter the quantity of runoff affecting these channels.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Surface Water Hydrology and Water Quality (Continued)			
Stream temperature	After reclamation from previous mining, and as streamflows and riparian canopy approach a more undisturbed condition, summer stream temperatures would likely be somewhat cooler and more typical of similarly sized undisturbed streams in the area. Stream temperatures in other subwatersheds in the study area not affected by previous mining activity would remain largely unchanged.	Decreased baseflows caused by groundwater pumping during active mining would alter stream water temperatures, especially in those subwatersheds most impacted by mining. Piping of Haile Gold Mine Creek around the pits would increase water temperatures in Haile Gold Mine Creek, potentially by more than 5.0 °F. These impacts would be major for Haile Gold Mine Creek within and downstream of the mining area. These impacts would be moderate for upper Haile Gold Mine Creek, the Little Lynches River downstream of Haile Gold Mine Creek, all but one unnamed tributary to the Little Lynches River, and the Unnamed Tributary southeast of the Project boundary. Impacts would be minor in Buffalo Creek, Camp Branch Creek, the unnamed tributary near Camp Branch Creek, and the Little Lynches River between Camp Branch Creek and Haile Gold Mine Creek. After mining and reclamation, stream thermal regimes may return to existing conditions, but only after streamflow regimes return and shading vegetation is re-established; this could take many years or decades.	Changes in stream temperature would be the same as the Applicant's Proposed Project except that the three unnamed tributaries filled by the proposed Ramona OSA would not be filled and would remain as streams. Baseflows in these three segments would be lower than under the No Action Alternative. The water temperature of these streamflows likely would not change by more than 5 °F based on the predicted percent change in simulated baseflows.
Water quality	Surface water quality within the Project boundary previously affected by mining activities would be expected to improve slowly over time following reclamation, particularly as the current passive treatment systems, the seep at Haile Pit, and the 188 Facility cease discharging. Water quality in other subwatersheds in the study area not affected by previous mining activity would remain largely unchanged.	Water quality in each stream in the study area would likely be indirectly affected from reduced baseflows during active mining; these impacts could continue during the post-mining period until baseflows stabilize. Direct discharge from the contact water treatment plant into Haile Gold Mine Creek would reduce water quality in this reach and the Little Lynches River downstream during mining and during reclamation. Water quality standards would not be violated because the contact water treatment plant would require an NPDES permit.	Impacts on water quality would be the same as the Applicant's Proposed Project except that the three unnamed tributaries filled by the proposed Ramona OSA would not be filled and would remain as streams. Reduced baseflows likely would cause indirect impacts on water quality in these segments. Modification of the configuration of Ramona OSA could alter the quality of runoff affecting these stream channels.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Surface Water Hydrology and Water Quality (Continued)			
Water quality (Continued)		Post-mining, the passive treatment cells that would be treating draindown water from the TSF and Johnny's PAG would affect water quality in Haile Gold Mine Creek. Violations of water quality standards are not expected, and the facility would be controlled under an NPDES permit issued by the SCDHEC. After traveling downgradient through the groundwater systems, interactions of groundwater with the backfilled pits could discharge to lower Haile Gold Mine Creek and the Little Lynches River, potentially exceeding water quality thresholds for certain constituents. Post-mining passive treatment at the TSF could affect water quality in upper and lower Camp Branch Creek and in all segments of the Little Lynches River downstream of Camp Branch Creek. The entire mine area has the potential to be affected by failure of containment systems or improper materials handling, except for the unnamed tributaries that drain to the Little Lynches River between Camp Branch Creek and Haile Gold Mine Creek, Buffalo Creek, and the Unnamed Tributary southeast of the Project boundary. These water quality impacts would be moderate for all of the streams in the study area except for Buffalo Creek, where impacts on water quality would be negligible.	
Water Supply and Floodplains			
Surface water and groundwater supplies and uses	Negligible changes in surface water and groundwater supplies would be expected unless future watershed development occurred.	Small changes in the flow of the Little Lynches River would not affect permitted water users as permitted surface water withdrawals in the Lynches River do not occur until 100 miles downstream of the Project boundary.	Effects on water supplies and users would be the same as the Applicant's Proposed Project.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Water Supply and Floodplains (Continued)			
Surface water and groundwater supplies and uses (Continued)		In the Little Lynches River immediately downstream of Haile Gold Mine, changes in surface water supplies would be minor, ranging from a 12% decrease to a 3.3% increase in available flow, minimally affecting downstream unpermitted surface water uses; during drought periods, however, these effects could be somewhat greater. Groundwater lowering due to mining would cause varying degrees of potential impacts at privately owned wells, springs and ponds that are used for water supply or other beneficial uses. Impacts may range from negligible to substantial, depending on the level of predicted drawdown and site-specific conditions. Alternative water supplies may be needed as mitigation measures to address potential impacts.	
Surface water and groundwater quality for water supply	Negligible changes in groundwater quality would occur. Surface water quality within the Project boundary previously affected by mining activities would be expected to improve slowly over time following reclamation, particularly as the current passive treatment systems, the seep at Haile Pit, and the 188 Facility cease discharging. Surface water quality in other subwatersheds in the study area not affected by previous mining activity would remain largely unchanged.	Watershed alterations, runoff, and contact water treatment plant discharges from mine operations may change stream water quality in the vicinity of the Project. Permit approvals would require that any changes maintain compliance with State water quality standards, and the changes are not expected to affect water quality for surface water users in or downstream of the proposed Project. Changes in groundwater quality may occur due to groundwater drawdown and influences from the pit lakes and backfilled pits. These changes in groundwater quality resulting from the Project are not expected to affect groundwater users in the Project area.	Changes in the quality of surface water and groundwater for water supply would be the same as the Applicant's Proposed Project.
Floodplain encroachment and elevation of the 100-year flood	No change in floodplain designation or flooding water levels would be expected.	No impacts on floodplain integrity would occur, and only negligible changes in 100-year flood water elevations would result from Project operations.	Impacts on floodplains would be the same as the Applicant's Proposed Project.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Wetlands and Other Waters of the United States			
Dredging and filling of wetlands	Because wetlands and Waters of the U.S. would not be filled, no direct impacts on wetlands or Waters of the U.S. would occur.	Direct impacts from dredge and fill activities for construction of pits, OSAs, the TSF, and haul roads would result in a permanent loss of 120.46 acres of wetlands and 26,460.54 linear feet of streams.	Direct impacts from dredge and fill activities for construction of pits, OSAs, the TSF, and haul roads would result in a permanent loss of 118.24 acres of wetlands and 19,349.32 linear feet of streams.
Hydrologic alteration	There would be no hydrologic alterations; therefore, indirect impacts on wetlands and Waters of the U.S. from hydrologic alterations would not occur.	Indirect impacts on an estimated 758.38 acres of wetlands and 80,483.35 linear feet of streams would result from changes in hydrology caused by groundwater lowering and surface water alterations. Some wetlands and streams would be expected to recover after groundwater pumping during active mining ceases and the water table recovers. In areas near the mine pits, wetlands and streams would be unlikely to regain their initial hydrologic regime, as groundwater levels would permanently remain 20 to 50 feet below existing levels and generally over the southern half of the Project boundary where groundwater levels would remain 1 to 20 feet below existing levels.	Indirect impacts from hydrologic alteration would be the same as the Applicant's Proposed Project except in the area of the Ramona OSA. Three streams that would not be directly impacted as a result of the reconfiguration of Ramona OSA would be indirectly impacted by sustained periods of drawdown during mining activities because of their proximity to pit dewatering activities. Baseflow impacts on these streams are considered major and would equate to the same amount of loss as the direct impacts on these streams under the Applicant's Proposed Project. Recovery and permanent changes in wetland and stream hydrology would be the same as for the Applicant's Proposed Project.
Water quality	There would be no dredging, filling, or other hydrologic alterations of wetlands and other Waters of the U.S.; therefore, no indirect impacts on water quality would occur.	Runoff from watershed disturbances related to construction and operation of Project facilities could cause increased sediment and sediment-associated pollutant loading to Waters of the U.S, although sediment detention ponds would be used to minimize these effects. Fugitive dust and air emissions from vehicles and heavy equipment also could increase stream sediment and pollutant loads in Waters of the U.S.	Effects on water quality in wetlands and Waters of the U.S. would be the same as the Applicant's Proposed Project, except that three tributaries associated with the proposed Ramona OSA would not be filled.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Wetlands and Other Waters of the United States (Continued)			
Water quality (Continued)		Direct discharges from the contact water treatment plant and pit dewatering would likely increase pH and concentrations of total suspended solids, cyanide, arsenic, cadmium, copper, lead, zinc, and selenium in Haile Gold Mine Creek and the Little Lynches River downstream.	Although the tributaries would remain in place, water quality in these streams could be affected by land disturbances associated with the pits and the reconfigured Ramona OSA, which could introduce polluted runoff into these streams. During reclamation, water quality impacts associated with reclaimed OSAs likely would be minimal.
Stream temperature	Following reclamation, the thermal regime of some streams previously affected by mining may become more typical of similarly sized streams in the area, with some small potential benefit to associated wetlands.	During active mining, decreased streamflows and increased water temperature during dry, warm conditions could lower dissolved oxygen concentrations. Increased temperatures also can be expected in waters that are piped aboveground, including the stream diversion pipe that releases into the lower portion of Haile Gold Mine Creek. Decreased dissolved oxygen concentrations may adversely affect some wetlands. After mining and reclamation, stream thermal regimes may return to existing conditions, but only after streamflow regimes return and shading vegetation is re-established. This could take many years or decades.	Same as the Applicant's Proposed Project, except that stream temperature changes as a result of baseflow reductions can be expected in the tributary reaches associated with the reconfigured Ramona OSA that otherwise would have been filled.
Habitat changes	There would be no dredging, filling, or other hydrologic alterations of wetlands or other Waters of the U.S.; therefore, no indirect impacts from habitat fragmentation would occur.	Physical alteration of the landscape and prolonged periods of change in seasonal hydrologic regime would result in permanent changes in some wetland habitats and the community structure. Habitat fragmentation would occur in both upstream and downstream areas, including upper Camp Branch Creek, upper Haile Gold Mine Creek, and lower Haile Gold Mine Creek. Habitat changes would be measured through long-term monitoring of water quality, thermal regimes, hydrology, vegetation, and aquatic organisms.	Changes in wetland habitats would be the same as the Applicant's Proposed Project, except for the three streams that would not be filled under the Modified Project Alternative. These streams would be subject to major hydrologic impacts that would then adversely affect habitat uses in the corridors, should the streams go dry from dewatering activities or be subject to pollutant discharges from upstream activities.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Aquatic Resources			
Stream fishes, macroinverte-brates, and aquatic biological condition	Reclamation and closure would continue, and the habitat quality in streams within the Project boundary previously affected by mining activities would be expected to improve slowly over time, including small to moderate incremental improvements in the biological integrity of Haile Gold Mine Creek. Other streams in the study area not previously affected by mining would remain largely unchanged.	The biological condition of the streams and subwatersheds directly and indirectly affected by mining would be expected to decline as a result of multiple stressors on the aquatic community, including a large percentage of the watershed area being disturbed, stormwater runoff, altered water temperatures, increased total suspended solids, and sediment loading. Some of the most likely biological impacts would include loss of sensitive insectivorous fish species, loss of invertebrate taxa, and dominance by tolerant omnivorous species, among others. The degree of impact on the biological health of stream communities would be greatest in more intensively developed subwatersheds, including upper and lower Haile Gold Mine Creek and upper Camp Branch Creek. Other subwatersheds such as Buffalo Creek, upper Little Lynches River, and possibly lower Camp Branch Creek would experience minor impacts on their biological condition or health. After reclamation and closure, the biological health and habitat quality in streams would improve, but the process would be slow and could take many years to decades to return to existing conditions.	Impacts on biological conditions would be the same as the Applicant's Proposed Project, except for impacts related to streams and aquatic habitats associated with the reconfigured Ramona OSA and the Holly and Hock TSF borrow areas. Streams draining the Holly and Hock TSF borrow areas would experience more intense temporary watershed disturbance and impacts of greater duration. The runoff from the OSAs would concentrate stormwater flows, resulting in greater hydrologic modification.
Sandhills chub and American eel	Habitat quality in streams previously affected by mining activities would be expected to improve slowly over time, with small to moderate incremental improvements in the biological integrity of the streams. Improved stream conditions are expected to have a small beneficial effect on habitat for the Sandhills chub, particularly individuals using Haile Gold Mine Creek.	Adverse impacts on the existing stream populations of Sandhills chub in Haile Gold Mine Creek and upper Camp Branch Creek would be moderate to major. Middle Haile Gold Mine Creek would be excavated, and upper Haile Gold Mine Creek would be completely fragmented and isolated from downstream segments for many years. Loss of Sandhills chub populations would be expected from upper Haile Gold Mine Creek due to flow reductions, higher stream temperatures, and potential water quality impacts. Lower Haile Gold Mine Creek would become marginally habitable or uninhabitable by Sandhills chub.	Effects on the Sandhills chub would be similar to the Applicant's Proposed Project, with greater impacts on Sandhills chub habitats in upper Camp Branch Creek. Because the headwaters of Camp Branch Creek would likely become marginally habitable or uninhabitable by Sandhills chub under the proposed Project, the difference between these two alternatives may not be meaningful.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Aquatic Resources (Continued)			
Sandhills chub and American eel (Continued)	Only small potential benefits to American eel are expected, based on their existing distribution being limited to the Little Lynches River downstream of the confluence with Camp Branch Creek. Habitat quality for Sandhills chub and American eel in other streams in the study area not previously affected by mining would remain largely unchanged.	Potential effects on American eel would be similar to those described above for "Stream fishes, macroinvertebrates, and aquatic biological condition."	Impacts on the American eel would be the same as the Applicant's Proposed Project because the eel was not found in Camp Branch Creek or the unnamed tributaries near the Ramona OSA.
Freshwater mussels and snails	Habitat quality in streams within the Project boundary previously affected by mining activities would be expected to improve slowly over time. These improvements may or may not ultimately result in habitat suitable for freshwater mussels and snails in Haile Gold Mine Creek. In the other subwatersheds not previously mined, habitat for mussels and snails would remain largely unchanged.	Freshwater mussels and snails would be unlikely to colonize or inhabit subwatersheds directly and indirectly affected by mining, resulting in minor impacts. Other subwatersheds such as Buffalo Creek and the Little Lynches River would experience stressors at a low level; therefore, any mussel populations present should be largely unaffected.	Impacts on freshwater mussels and snails would be similar to the Applicant's Proposed Project, except for impacts related to streams and aquatic habitats in the vicinity of the Ramona OSA. Reconfiguration of the Ramona OSA would avoid filling three tributaries that would then experience less intense stressors. Nevertheless, they would be affected by reduced baseflows and would not be expected to support freshwater mussels.
Amphibians and reptiles (herptiles)	Herptile populations would not be expected to change in any of the subwatersheds, except for Haile Gold Mine Creek. In the future, habitats along Haile Gold Mine Creek may be better able to support more amphibians and reptiles as the creek naturally transitions to a more natural stream with improved riparian conditions following reclamation.	Headwater streams, wetlands, and upland terrestrial habitat used by amphibians and reptiles would be directly and indirectly affected by mining. Upper Haile Gold Mine Creek would essentially be isolated from the downstream section of the watershed, and habitat for many herptile species would be fragmented and indirectly degraded. Impacts on wetlands would result in indirect impacts on herptiles because of their inability to migrate to other suitable habitats and isolation of individuals.	Impacts on amphibians and reptiles would be similar to the Applicant's Proposed Project, except for impacts related to wetlands, streams, and aquatic habitats in the vicinity of the reconfigured Ramona OSA and the Holly and Hock TSF borrow areas.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Aquatic Resources (Continued)			
Amphibians and reptiles (herptiles) (Continued)		Buffalo Creek, upper Little Lynches River, and possibly lower Camp Branch Creek would experience low stresses, and populations of amphibians and reptiles would likely experience minor impacts. Herptiles using the remaining subwater-sheds in the study area would likely be subject to moderate impacts from habitat fragmentation and hydrologic alteration.	Moderate impacts on amphibians and reptiles using the terrestrial and aquatic environments in this area would be expected for the duration of the active mining period.
Pit lakes	The habitat quality in existing pit lakes within the Project boundary may improve slowly over time following reclamation. The existing pit lakes currently support very limited biological communities and few fish species. This would be expected to continue unless management actions are taken.	During the active mining period, all aquatic communities would be expected to be permanently lost as all the existing pit lakes would be fully drained and excavated. Champion Pit, Small Pit, and Ledbetter Pit would slowly fill to become pit lakes over a period from approximately 10 to 40 years. Their changing water quality would be monitored during that period, including adding lime as needed to adjust pH. Water quality monitoring would occur in all three pit lakes throughout the reclamation period to ensure that they eventually meet applicable State water quality standards. Haile has not proposed restocking any of the pit lakes with fish; therefore, there is little likelihood for populations to become re-established or recruit within any pit lake during the reclamation period. Ledbetter Pit Lake eventually would be connected to Haile Gold Mine Creek, possibly resulting in some fish moving into the pit lake. Periphyton, algal, and macroinvertebrate populations would be expected to repopulate the lakes in a shorter time period, but mainly with tolerant species and not until filling of the pit lakes is complete.	Impacts on the habitat quality of pit lakes during the active mining period and post-mining reclamation period would be the same as the Applicant's Proposed Project.
Terrestrial Resources			
Vegetation cover and type	Previously disturbed and reclaimed vegetation communities within the Project boundary would continue to change and mature over time, with improvements in plant and habitat diversity.	Approximately 2,819 acres of vegetation would be cleared for Project facilities and the mining pits; 67% of this area would consist of previously disturbed vegetation communities. Species composition in natural areas would change from existing riparian, scrub, and forested areas to modified managed upland vegetation-scrub type post-mining. In the long term, after reclamation, vegetation communities would continue to change and mature over time, with improvements in plant and habitat diversity.	Impacts on vegetation and cover type during the active mining period and post-mining reclamation period would be the same as the Applicant's Proposed Project.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Terrestrial Resources (Continued)			
Vegetation cover and type (Continued)		Indirect impacts on vegetation, including effects from clearing and from reduction in water availability, may include stunted growth, greater susceptibility to disease, and succession of more drought-tolerant species.	
Sensitive plant species	Sensitive plant species are not likely to be disturbed; therefore, no impacts on sensitive species are expected.	Loss of nestronia, a state-listed sensitive plant species, would occur at 13 locations.	Impacts on sensitive plant species would be the same as the Applicant's Proposed Project.
Wildlife and wildlife habitat	Wildlife habitat would be expected to slowly improve over time as vegetation continues to grow in previously mined and reclaimed areas.	Temporary loss of wildlife habitat from removal of vegetation and increased habitat fragmentation would occur. After reclamation is completed, reclaimed areas would provide habitat for re-establishment of wildlife species that were present prior to mining. Wildlife would temporarily avoid areas disturbed by construction activities and noise.	Impacts on wildlife and wildlife habitat would be the same as the Applicant's Proposed Project, except that 47 fewer acres of habitat would be removed.
State-listed wildlife species	State-listed wildlife species would likely not be disturbed; therefore, no impacts on state-listed species would occur.	The potential exists for direct and indirect disturbance and mortality of wildlife during mine operations, including some state-listed wildlife species. This potential would be reduced considerably post-mining. Reclaimed areas would provide habitat for re-establishment of state-listed wildlife species that were present prior to mining. Wildlife would temporarily avoid areas disturbed by construction activities and noise.	Impacts on wildlife and wildlife habitat would be the same as the Applicant's Proposed Project, except that 47 fewer acres of habitat would be removed.
Disturbance of wildlife	As the current reclamation and closure activities are completed, the potential for contact between wildlife and road traffic would be reduced, resulting in less potential for wildlife mortality.	The potential exists for direct and indirect disturbance and mortality of wildlife during mine operations. This potential would be reduced considerably post-mining.	Disturbance of wildlife would be the same as the Applicant's Proposed Project.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Terrestrial Resources (Continued)			
Potential contamination of wildlife	A very low level of potential contamination exists from previously disturbed and reclaimed mine features such as Chase Hill Pad. Only minor incidental impacts would occur until mine closure is complete.	Wildlife could be exposed to cyanide at the TSF during mine operations, resulting in potential mortality. The risk of secondary exposure would be minor. Cyanide gas would be unlikely to cause ecotoxicity. There would be little or no risk of cyanide exposure to wildlife after reclamation of the TSF.	Potential contamination of wildlife would be the same as the Applicant's Proposed Project.
Federally Listed Species			
Federally listed species	No threatened, endangered, or candidate (TEC) species or their critical habitat are present within the Project boundary; therefore, no effects on TEC species would be expected.	No TEC species or their critical habitat are present within the Project boundary; therefore, the proposed Project would not affect TEC species.	Impacts on TEC species and their critical habitat would be the same as the Applicant's Proposed Project (no impact).
Socioeconomics and Environmental Justice			
Gold production values and markets	There would be no production of gold and silver.	Approximately $151.1 million in gold and silver would be produced annually during the active mining period.	Annual gold and silver production during the active mining period would be the same as the Applicant's Proposed Project.
Direct economic effects at Haile Gold Mine	Current employment levels and associated economic effects related to ongoing mine closure would be extended for some time.	Direct employment would increase during the active mining period, reaching a maximum of 420 individuals. Employment would be reduced during post-mining closure and reclamation.	Direct economic effects would be the same as the Applicant's Proposed Project.
Regional economic effects	Minor regional economic benefits in the local and statewide economies related to ongoing closure and monitoring of previous mining at the Haile Gold Mine site would continue.	During the active mining period, output (production), income, and jobs in the local and statewide economies would increase. This increase would be reduced during the post-mining closure/reclamation period. Some limited regional economic effects would extend for a number of years during long-term monitoring.	Regional economic effects would be the same as the Applicant's Proposed Project.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Socioeconomics and Environmental Justice (Continued)			
Tax revenue	Ongoing closure and monitoring activities in the Project area would result in minor effects on local tax revenues.	During the active mining period, increased fee/tax revenues, fee-in-lieu-of taxes ($1.1 million annually), sales taxes ($327,000 annually), and state income taxes ($2.5 million annually) are expected primarily from increased employment, direct spending, and indirect economic effects. During post-mining closure and reclamation, tax revenues related to employment and the associated economic activity would decline to a modest level.	Expected local and state tax revenues would be the same as the Applicant's Proposed Project.
Population and housing	Ongoing closure and monitoring activities in the Project area are not expected to increase local population or change the demand for housing.	Increased employment and associated regional economic activity may cause a minor increase in population and demand for local housing.	Potential increases in population and housing demand would be the same as the Applicant's Proposed Project.
Property values	Changes in property values in the Project area or vicinity are unknown.	Changes in property values as a result of the Applicant's Proposed Project are unknown.	Changes in property values would be the same as the Applicant's Proposed Project (unknown).
Public services	Ongoing closure and monitoring activities in the Project area are not expected to change requirements for public services.	Construction, operations, and closure/reclamation of the Applicant's Proposed Project would increase the demand for local public services.	Changes in demand for public services would be the same as the Applicant's Proposed Project.
Environmental justice	Ongoing closure and monitoring activities in the Project area would not cause adverse environmental or socioeconomic effects to environmental justice populations. .	Construction, operations, and closure/reclamation of the Applicant's Proposed Project would cause beneficial effects on environmental justice populations from local and regional economic benefits (jobs and income).	Benefits to environmental justice populations would be the same as the Applicant's Proposed Project.
Land Use			
Land use	Ongoing closure and monitoring activities in the Project area would not change existing land use; ongoing exploratory activity would cease.	Approximately 2,612 acres within the Project boundary would be converted from past land uses to mining, consistent with the current zoning.	Land use changes would be the same as the Applicant's Proposed Project.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Land Use (Continued)			
Land ownership	Applicant may sell some or all of the property within the Project boundary; the Haile-owned minerals laboratory at the Kershaw Industrial Park likely would be closed.	No change in ownership would be expected for Project lands, unless the mine is sold. Ownership of parcels proposed for compensatory mitigation in Haile's Compensatory Mitigation Plan would be transferred to the South Carolina Department of Natural Resources Heritage Preservation Program.	Land ownership changes would be the same as the Applicant's Proposed Project.
Zoning and land management plans	Ongoing closure and monitoring activities in the Project area would be consistent with the Lancaster County Mining District zoning designation and consistent with applicable land management plans.	Construction, operations, and closure/reclamation of the Applicant's Proposed Project are consistent with the Lancaster County Mining District zoning designation and consistent with applicable land management plans.	Consistency with the Lancaster County Mining District zoning designation and applicable land management plans would be the same as the Applicant's Proposed Project.
Special-status farmland	Ongoing closure and monitoring activities in the Project area would not disturb currently undisturbed prime farmland and farmland of statewide and local importance.	The Applicant's Proposed Project would disturb and convert to non-agricultural uses approximately 186 acres of prime farmland and approximately 246 acres of farmland of statewide or local importance.	Approximately 33 fewer acres of prime farmland would be disturbed (153 acres of prime farmland) and approximately 246 acres of farmland of statewide or local importance would be disturbed and converted to non-agricultural uses.
Transportation			
Traffic congestion	Roadway intersections would not experience increased traffic and congestion in the future; the current Level of Service (LOS) A would be maintained during peak hours.	The Applicant's Proposed Project would increase delays of up to 6 seconds per vehicle at intersections. All intersections would maintain the current LOS A during peak hours. Localized travel delays from one-way traffic flagging may occur during construction activities on roadways.	Impacts related to traffic congestion would be the same as, or slightly less than, the Applicant's Proposed Project.
Conflicts or collisions at access points	No changes to existing Haile Gold Mine access points would be implemented, but a slight increase in the likelihood of a conflict or collision at existing access points could occur from a projected increase in area traffic from traffic growth.	Potential traffic conflicts would be minimized by closing Snowy Owl Road, constructing a proposed access driveway onto US Highway 601 (US 601) at the mine entrance, and building two overpasses over US 601.	The potential for conflicts or collisions would be the same as the Applicant's Proposed Project.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Transportation (Continued)			
Roadway wear and maintenance	The projected future traffic growth rate of 1% per year would slightly increase wear of roadway surfaces and would increase road maintenance requirements. Increases in truck traffic would be relatively minor.	Increases in truck traffic of 7.9% during construction and 7.3% during operations would cause additional wear on US 601, an approved overweight truck route. The roadway would continue to be maintained by the South Carolina Department of Transportation, with adequate funding available for roadway maintenance.	Effects on roadway wear and maintenance requirements would be the same as the Applicant's Proposed Project.
Cultural Resources			
Historic properties	Existing cultural resources would not be affected or significantly altered by ongoing closure and monitoring activities. Some historic properties would continue treatment under existing Memoranda of Agreement.	The Applicant's Proposed Project would adversely affect 14 NRHP-eligible historic properties and potentially affect 4 NRHP unevaluated historic properties.	Effects on historic properties would be the same as the Applicant's Proposed Project.
Indirect visual, auditory, or atmospheric changes to historic properties	No visual, auditory, or atmospheric impacts would occur to historic properties from ongoing closure and monitoring activities related to previous mining within the Project boundary.	Proposed Project activities would result in indirect impacts on 1 NRHP-listed property, 1 NRHP-eligible property, and 3 NRHP unevaluated properties.	Effects on historic properties would be the same as the Applicant's Proposed Project.
Visual Resources and Aesthetics			
Mining operations	The Project area would remain in its current state, and the visual resources would not be affected or significantly altered.	Short-term visual impacts would occur within 0.4 mile of the area of active mining, principally from unvegetated overburden piles that are substantially higher than, and therefore contrast with, the existing landscape. Limited long-term visual impacts would remain after vegetation cover is developed on the OSAs and the TSF during reclamation.	Visual impacts from mining operations would be the same as the Applicant's Proposed Project, except for decreased visual impacts at the Ramona OSA because of its smaller mass and increased visual impacts at the Holly and Hock TSF borrow areas from the increased mass related to overburden storage there.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Visual Resources and Aesthetics (Continued)			
Project facilities and construction activities	The Project area would remain in its current state, and visual resources would not be affected or significantly altered. Visual resources would be similar to existing conditions.	Short-term visual impacts would be caused by construction of perimeter fencing, presence of construction vehicles and equipment, potential dust emissions, and new mining structures. Long-term visual impacts would be limited, including at the Forty Acre Rock Heritage Preserve, because facilities in the Project area would be re-graded, demolished, salvaged, or removed as appropriate.	Visual impacts from Project facilities and construction activities would be the same as the Applicant's Proposed Project, except for an increase in vehicles and equipment associated with the use of the Holly and Hock TSF borrow areas as OSAs.
Project lighting	Ongoing closure and monitoring activities would not require construction of new lighting sources. No additional lighting impacts are expected to occur.	Short-term visual impacts would result from Project-related lighting that would increase levels of ambient light in and near the Project area. No long-term ambient light impacts are expected because Project lighting would be removed during reclamation activities.	Effects of Project lighting would be the same as the Applicant's Proposed Project.
Recreation Resources			
Public recreation resources	The Project area would remain closed to most public access, with no public recreation opportunities. No further change would be expected.	During active mining, the Project area would be closed to all public access, resulting in negligible impacts on recreation resources. Post-reclamation, the potential benefits of future recreational opportunities in the Project area would depend on post-reclamation land use and public recreational access plans.	Impacts on public recreation resources would be the same as the Applicant's Proposed Project.
Recreation management plans	*The South Carolina Thread Trail Master Plan* includes only proposed trail segments. The final trail likely would be routed to conform to compatible land use and zoning.	The final route of the Tread Trail has not been determined. If it is not located within the Project boundary, no conflict with the trail would occur. Its future location within the Project boundary would depend on compatibility with post-mining land use, public access, and public safety.	Potential conflicts with recreation management plans would be the same as the Applicant's Proposed Project.
Air Quality			
Criteria pollutants	Air quality would not be affected or significantly altered and would be similar to existing conditions.	Air emissions from mining and closure/reclamation activities would primarily be particulate (PM) emissions. Other criteria pollutants emitted include VOCs, NOx, CO, and SO_2. Criteria pollutants would be below major source thresholds, National Ambient Air Quality Standards, and the Prevention of Significant Deterioration (PSD) Class II increment. Direct impacts on air quality would be minor.	Impacts on air quality from criteria pollutants would be similar to the Applicant's Proposed Project, except for an increase in emissions from vehicles and equipment at the Holly and Hock TSF borrow area OSAs and decreased emissions from the sources at the Ramona OSA.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Air Quality (Continued)			
Fugitive PM emissions	Generation of fugitive PM emissions from monitoring and maintenance activities would be similar to existing conditions.	Fugitive PM emissions (dust) would be generated from drilling, blasting, hauling, materials handling, maintenance, and support activities. Fugitive emissions for several pollutants also would occur during blasting operations but would be reduced by the physical characteristics of the mine pit. Emissions would be minimized with avoidance and minimization measures.	Impacts from fugitive dust would be similar to the Applicant's Proposed Project, except for an increase in fugitive PM emissions from vehicles and equipment at the Holly and Hock TSF borrow area OSAs and decreased emissions from those sources at the Ramona OSA.
Greenhouse gases (GHGs)	The generation of GHGs that would occur from ongoing monitoring and maintenance activities would be similar to existing conditions.	Direct GHGs would be emitted from combustion sources used during mine operations. Indirect GHGs would be emitted from electricity used at the mine, waste management, and delivery vehicles. Direct GHGs would be below the Mandatory Reporting of Greenhouse Gases Rule and the PSD and Title V Greenhouse Gas Tailoring Rule thresholds. The direct annual GHG emissions from the Proposed Project would include 16,360 metric tons from stationary sources and 47,551 metric tons from mobile sources of CO_2-e. The Draft NEPA *Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions* also would exempt the proposed Project from calculating and disclosing the annual direct and indirect GHG emissions.	Generation of GHGs would be similar to the Applicant's Proposed Project, except for an increase in GHG emissions from vehicles and equipment at the Holly and Hock TSF borrow area OSAs and decreased GHG emissions from vehicles and equipment at the Ramona OSA.
Toxic and hazardous air pollutants (TAPs and HAPs)	The generation of TAPs and HAPs that would occur from ongoing monitoring and maintenance activities would be similar to existing conditions and would decline over time as the former mine is closed.	TAPs and HAPs would be generated from the gold refining process, from lighting system generators, and from the sump pump engines. Approximately 4.65 tons per year of hydrogen cyanide (HCN) would be emitted at the Mill and TSF. Monitoring for HCN would occur in collaboration with the SCDHEC. Calculated TAPs and HAPs would be below major source thresholds.	Impacts from TAPs and HAPs would be similar to the Applicant's Proposed Project, except for an increase in TAPs and HAPs from increased vehicles and equipment at the Holly and Hock TSF borrow areas and decreased TAPs and HAPs from decreased vehicles and equipment at the Ramona OSA.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Noise and Vibration			
Noise from mining activities	Ambient noise would likely not change and would be similar to existing conditions. Noise levels would decline over time to pre-mining levels as the former mine is closed.	Increased noise would result from process equipment and from on-road and off-road equipment used during mining. Noise levels would not exceed standards.	Noise impacts would be similar to the Applicant's Proposed Project, except for increased noise from increased vehicles and equipment at the Holly and Hock TSF borrow areas and decreased noise from fewer vehicles and equipment at the Ramona OSA.
Vibration from mining activities	Ambient vibration levels would not be affected and would be similar to existing conditions. Vibration levels would decline over time to pre-mining levels as the former mine is closed.	Vibration would result from process equipment and from on-road and off-road equipment used during mining. Vibration levels would not exceed standards.	Vibration impacts would be similar to the Applicant's Proposed Project, except for increased vibration from increased vehicles and equipment at the Holly and Hock TSF borrow areas and decreased vibration at the Ramona OSA from decreased vehicles and equipment.
Noise and vibration from blasting	No ongoing blasting or vibration would occur. When closure of the former mine is complete, noise and vibration would return to pre-mining background levels.	Noise and vibration would result from blasting activity during mining. Vibration and noise levels from blasting would be below applicable standards.	Noise and vibration from blasting would be largely the same as the Applicant's Proposed Project, but construction noise in the vicinity of the Holly and Hock TSF borrow areas would last for a longer duration when those OSAs were constructed.
Health and Safety			
Project facility hazards	The negligible potential for injuries associated with the ongoing monitoring required by previous permits would decline over time as the former mine is closed.	The potential for injury from Project facilities would increase during active mining and post-mining but would be reduced with appropriate training. A minor and temporary impact would result if an injury or illness should occur.	The potential for injury from Project facilities would be the same as the Applicant's Proposed Project.
Tornadoes, hurricanes, and other high-wind events	The existing potential for tornadoes, hurricanes, and other high-wind events and the associated damage to the Project area would continue but would decline over time as the former mine is closed.	There is a minor potential for damage to Project facilities and equipment from high-wind events.	Potential effects from high-wind events would be the same as the Applicant's Proposed Project.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Health and Safety (Continued)			
Excessive precipitation	There would be no potential for facility failures; tailings dam breaks; or flooding of mine facilities, pits, or equipment because no new facilities would be built. The existing potential for flooding would not change.	The probability of facility failures; tailings dam breaks; or flooding of mine facilities, pits, or equipment resulting from excessive precipitation events is very low.	The probability of effects from excessive precipitation would be the same as the Applicant's Proposed Project.
Freezing conditions	There would be no potential for mine facility components to freeze. The existing potential for freezing conditions in the Project area would continue.	The probability for temporary operational changes needed at the Duckwood TSF, slurry delivery pipeline, and mine facilities due to ice formation within pipelines is very low.	The probability of effects from freezing conditions would be the same as the Applicant's Proposed Project.
Wildland fires	The existing potential for damage from wildland fires in the Project area would not change.	There would be a minor increase in the potential for moderate or long-term wildland fire damage.	The potential for wildfire damage would be the same as the Applicant's Proposed Project.
Increased demand for emergency response	The demand for emergency response services would decrease as ongoing monitoring of reclaimed sites declines.	There would be a small potential for short-term increased demand on local responders for emergency response.	The potential for increased demand for emergency response would be the same as the Applicant's Proposed Project.
Hazardous Materials and Waste			
Handling of hazardous materials	Ongoing monitoring of the reclaimed sites would continue in accordance with previous permit requirements. Ongoing activities that require the use of hazardous materials such as diesel fuel would decline over time as the past mine is closed.	Training requirements and safety precautions would be in place to ensure proper handling of hazardous materials and waste, resulting in low potential impacts.	The potential for impacts from handling of hazardous materials would be the same as the Applicant's Proposed Project.

Table 2-15 Summary of Potential Impacts by Alternative and Environmental Resource (Continued)

	No Action Alternative	Applicant's Proposed Project	Modified Project Alternative
Hazardous Materials and Waste (Continued)			
Storage of hazardous materials	Storage of hazardous materials would decline over time as monitoring of reclaimed sites declines. Ongoing monitoring would occur in compliance with previous permit requirements.	Design features of Project facilities, safety guidelines and plans, personnel training, and storage procedures would manage the potential accidental releases of hazardous materials within the Project area, resulting in a low potential for impacts.	The potential for impacts from storage of hazardous material would be the same as the Applicant's Proposed Project.
Transport of hazardous materials in the Project area	Ongoing monitoring of reclaimed sites would decline and cease and the associated transport of hazardous materials and waste would discontinue.	Design features of Project facilities, safety precautions and plans, and transportation requirements would manage the potential accidental releases of hazardous materials within the Project area, resulting in a low potential for impacts.	The potential for impacts from transport of hazardous materials in the Project area would be the same as the Applicant's Proposed Project.
Disposal of hazardous materials	Ongoing monitoring of reclaimed sites would decline and cease, as would the associated disposal of hazardous materials.	Proper disposal measures would be in place for disposal of hazardous materials outside the Project boundary, resulting in a low potential for impacts.	Potential impacts from disposal of hazardous materials would be the same as the Applicant's Proposed Project.

CO = carbon monoxide; CO_2-e = carbon dioxide equivalents; NOx = oxides of nitrogen; OSA = Overburden storage area; PAG = potentially acid-generating; PM = particulate matter; SCDHEC = South Carolina Department of Health and Environmental Control; SO_2 = sulfur dioxide; TSF = tailings storage facility; VOC = volatile organic compounds.

2.9 Literature Cited

AMEC. See AMEC Environment & Infrastructure.

AMEC Environment & Infrastructure. 2012a. Technical Memorandum Re: Preliminary Evaluation of Separate Tailing Storage Facilities for Leached Flotation Concentrate and Leached Flotation Tailing. Memo from AMEC Environment & Infrastructure, Inc. to Haile Gold Mine, Inc. May 8.

AMEC Environment & Infrastructure. 2012b. Exhibit 2, AL-02-04, Final Alternatives 40 Million Ton Facilities.

Bauer, A. 2007. BioMineWiki. Website: http://wiki.biomine.skelleftea.se/wiki/index.php/Image:HeapLeaching.png. Accessed on March 30, 2007.

Behre Dolbear & Company. 2007. Haile Mine Project Kershaw, Lancaster County, South Carolina 34° 34' 46" N latitude 80° 32' 37" W longitude. July 17.

Canadian Institute of Mining, Metallurgy and Petroleum. 2005. CIM Definition Standards.

CIM. See Canadian Institute of Mining, Metallurgy, and Petroleum.

Ecological Resource Consultants, Inc. 2011. Technical Memorandum Re: Haile Gold Mine Supplemental Alternatives Analysis. May 16.

Ecological Resource Consultants, Inc. 2012. Revised Department of the Army Permit Application, Detailed Impact Maps, Sheets 1–8, August 15.

ERC. See Ecological Resource Consultants, Inc.

European Commission. 2004. Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities. July. Website: http://www.virotecitalia.com/pdf/DOC8.Best%20Available%20Technologies-%20estratto.pdf. Accessed on June 25, 2013.

Eurostat. 2010. Impacts of Gold Extraction in the EU, 2010. Eurostat 50304.2009.001-2009.846 Information Hub Enquiry 2010-001. Website: http://ec.europa.eu/environment/waste/mining/pdf/IH_2010-001.pdf.

Genesis Consulting Group. 2011. Environmental Assessment for Haile Gold Mine Project, prepared for Haile Gold Mine. Prepared by Genesis Consulting Group. December 3, 2010. Revised January 11, 2011.

Gold Investing News. 2013. World Class Gold Deposits. Website: http://goldinvestingnews.com/ world-class-gold-deposits. Accessed on March 11, 2013.

Golder Associates. 2010 . Report on Feasibility Level Pit Slope Evaluation. October.

Haile. See Haile Gold Mine, Inc.

Haile Gold Mine, Inc. 2011. Joint Application Form for Activities Affecting Waters of the United States or Critical Areas of the State of South Carolina. January 11.

Haile Gold Mine, Inc., 2012a. Haile Gold Mine, Inc.'s Response to USACE's July 11, 2012 Request for Additional Information RAI No. 3, Exhibit RAI 3- AL-14d-2: Central Electric Power Cooperative Transmission Projects Siting and Environmental Review Process, Central Electric Power Cooperative, Inc. August 13.

Haile Gold Mine, Inc. 2012b. Revised Joint Application Form for Activities Affecting Waters of the United States or Critical Areas of the State of South Carolina. August 15.

Haile Gold Mine, Inc. 2012c. Haile Gold Mine, Inc.'s Response to USACE's March 20, 2012 Request for Additional Information (RAI) No. 2 (AL-01 to AL-12), April 19.

Haile Gold Mine, Inc. 2012d. Response to Request for Additional Information (RAI) No. 3, August 13, 2012. Exhibit RAI 3-WQ-14: Supplemental Information: Past Activities at Haile Gold Mine Site with Information about Reclamation and Water Quality Records. August 11.

Haile Gold Mine, Inc. 2012e. Exhibit RAI 2-AL-02-01, TSF Alternatives per Level 1 Screening Criteria.

Haile Gold Mine, Inc. 2012f. Anticipated Mine Production and Operations Report. December.

Haile Gold Mine, Inc. 2012g. Haile Gold Mine, Inc.'s Response to USACE's July 11, 2012 Request for Additional Information RAI No. 3 (WQ-13 to WQ-17), August 13, 2012. Exhibit RAI 3-WQ-14: Supplemental Information: Past Activities at Haile Gold Mine Site With Information About Reclamation and Water Quality Records. August 11.

Haile Gold Mine, Inc. 2013a. Haile Gold Mine, Inc.'s Supplemental Response to USACE's March 20, 2012 Request for Additional Information RAI No. 2 (AL-01) June 19, 2013.

Haile Gold Mine, Inc. 2013b. Haile Gold Mine, Inc.'s Supplemental Response to USACE's July 11, 2012 Request for Additional Information RAI No. 3, Exhibit RAI 3-WW-18: Table of the Comparison of Onsite Alternatives, June 2013.

Hendrix, J.L. 2005. Is there a green chemistry approach for leaching gold? *In* Sustainable Mining. Paper 2. Website: http://digitalcommons.unl.edu/chemengmining/2.

IGIE. See Independent Group of International Experts.

IMC. See Independent Mining Consultants, Inc.

Independent Group of International Experts. 2006. Environmental Impact Assessment for Roșia Montană Project, Chapter 5 Alternatives Analysis. Website: http://en.rmgc.ro/Content/uploads/eiaen/alternatives.pdf.

Independent Mining Consultants, Inc. 2013. Scoping Evaluation, Underground Stope Mine, Haile Gold Mine. Prepared for Haile Gold Mine, Inc. June.

International Cyanide Management Institute. 2014. Website: www.cyanidecode.org. Accessed on February 7, 2013.

Kinross. 2012a. Kettle River-Buckhorn, USA. December 31, 2012. Website: http://www.kinross.com/operations/operation-kettle-river-buckhorn-usa.aspx. Accessed on March 11, 2013.

Kinross. 2012b. Round Mountain, USA. Website: http://www.kinross.com/operations/operation-round-mountain,-usa.aspx. Accessed on February 3, 2014.

Kinross. 2012c. Fort Knox, Alaska. Website: http://www.kinross.com/operations/operation-fort-knox-alaska-usa.aspx. Accessed on February 3, 2014.

M3 Engineering & Technology Corporation. 2010. Haile Gold Mine Project NI 43-101 Technical Report, Feasibility Study. Prepared for Romarco Minerals, Inc. December 29.

M3 Engineering & Technology Corporation. 2012. Concentrate Separation Scoping Evaluation. Prepared for Romarco Minerals, Inc. May 24.

MASC. See Mining Association of South Carolina.

Mining Association of South Carolina. 2014. Construction Minerals. Website: http://www.scmines.com/construction.html. Accessed on February 8, 2014.

Romarco. See Romarco Minerals, Inc.

Romarco Minerals, Inc. 2011. Annual Report 2011. Toronto, Canada.

Romarco Minerals, Inc. 2012. Romarco Provides Regional Project Update, January 17. Website: http://www.romarco.com/Newsroom/News-Releases/News-Releases-Details/2012/Romarco-provides-regional-project-update1127948/default.aspx accessed February 3, 2012.

Romarco Minerals, Inc. 2013. 2012 Annual Report. Toronto, Canada.

Rural Utilities Service. 2001. Design Guide for Rural Substations. (RUS Bulletin 1724E-300.) U.S. Department of Agriculture. June. Website: http://www.usda.gov/rus/electric. Accessed on December 4, 2013.

Rural Utilities Service. 2009. Design Manual for High Voltage Transmission Lines. (RUS Bulletin 1724E-200.) U.S. Department of Agriculture, Rural Utilities Service, Electric Staff Division. May. Website: http://www.usda.gov/rus/electric/bulletins.htm. Accessed on December 4, 2013.

RUS. See Rural Utilities Service.

Schafer Limited. 2012. Memorandum: Geochemistry Section for Tailings Alternative Study. Memo from William M. Schafer, Schafer Limited to Mr. Johnny Pappas, Haile Gold Mine, Inc., May 4.

Schlumberger Water Services. 2010. Haile Gold Mine: Baseline Hydrological Characterization Report. Schlumberger Water Services. Prepared for Haile Gold Mine, Inc. November.

USACE. See U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers. 2013. Alternatives Development and Evaluation for the Haile Gold Mine Project Environmental Impact Statement. Preliminary Report. Charleston District, South Carolina. Prepared by Cardno ENTRIX. July. Updated November 2013.

U.S. Geological Survey. 1988. Carolina Slate Belt Gold Deposits in Virginia, North Carolina, South Carolina, and Georgia. USGS Information Handout, October 1998. Website: http://pubs.usgs.gov/info/ayuso1/. Accessed on March 11, 2012.

U.S. Geological Survey. 2012. Gold Deposits of the Carolina Slate Belt, South Eastern United States: Age and Origin of the Major Gold Producers. (USGS Open-File Report 2012-1179.)

USGS. See U.S. Geological Survey.

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